POWER

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The Power Show

WHO does not recall the pleasure that he derived, the mental stimulus that he got, the impulses that his inventive faculty received and the many interesting and useful things of the existence and manner of operation of which he learned at the mechanical exhibitions to which he was taken as a child?

The mechanical features may have been only incidents of the country fair. In the large cities there were Mechanics' Fairs and exhibitions by mechanical and industrial institutions.

The history of many an art is traceable by the demonstrations that it has made at the great national and international expositions.

Of how many things is it true that you first saw them or got your first knowledge of them at some sort of a "show"?

This is an age of specialty and differentiation. We have shows of all kinds, and among the latest of these is the Power Show.

Those that have been held at New York the last three years at the time of the annual meetings of the Mechanical and Refrigerating Engineers have been progressively successful.

They have afforded opportunity for the impressive demonstration of the important part that power plays in modern social as well as industrial life; of the magnitude and complexity of the processes of its generation and conversion.

They have afforded opportunity for those who, by study of the principles involved and experiment in their application, have, within a comparatively few years, cut the cost of power generation in two.

They have afforded opportunity for those who have discovered and invented and developed the materials and appliances by which the many power-plant economies incidental to this improvement have been effected, to explain and demonstrate to prospective users and operators, their principles and possibilities.

And many an engineer has gone away with thoughts of where he could use this or that or how the other would solve one of his problems; and many an operator has gone away with a better idea of what is behind and inside of the apparatus that he handles and how to get better results from it.

Let us hope that the first Engineering and Power Exposition held at Chicago in connection with the Midwest Power Conference will be equally succesful.

F. R. Low

Powdered Coal Universal Fuel at American Spiral Pipe Works

IN 1921 the American Spiral Pipe Works, of Chicago, was operating a number of large heating furnaces, some fired with fuel oil and others with coal. At that time improvements in economy were desirable and it was decided to install a powdered-coal preparation plant, so that a change to this fuel could be made gradually on all the furnaces. Immediate attention was not given to the power plant, but it soon become apparent that some remodeling would be necessary as part of the equipment had become antiquated and the rest of the plant did not give the economy that could be obtained with a modern installation.

In the boiler room there were two hand-fired units, which had been in service many years and two horizontal, three-pass, vertically baffled water-tube boilers, equipped with chain grates, installed in 1909. From the safety viewpoint the hand-fired boilers had to be replaced, and while the horizontal boilers were still serviceable, mediocre results were obtained owing to their low settings.

It was an open question whether to put in new stoker-fired boilers or take advantage of the powdered-coal preparation plant already available and install a new boiler equipped to burn this fuel that would be large enough to supply the demands of the entire plant. After a thorough investigation it was decided to install a modern boiler utilizing pulverized coal as fuel, to discard the hand-fired boilers and to retain the two horizontal stoker-fired boilers as a reserve. To make the service as reliable as possible, the pulverized-coal feeders were equipped with dual motor drives which take current from the plant or from central-station service, duplicate blowers were provided to supply the primary air and the five horizontal, flared-type powdered-coal burners were supplemented by three oil burners which may be used to carry the load in case of failure of the powdered-coal supply. Besides, the growing requirements of the works will soon call for the installation of an additional boiler unit which will burn powdered coal, so it will be for only a comparatively short period that the burden of the steam requirements will be carried by one boiler.

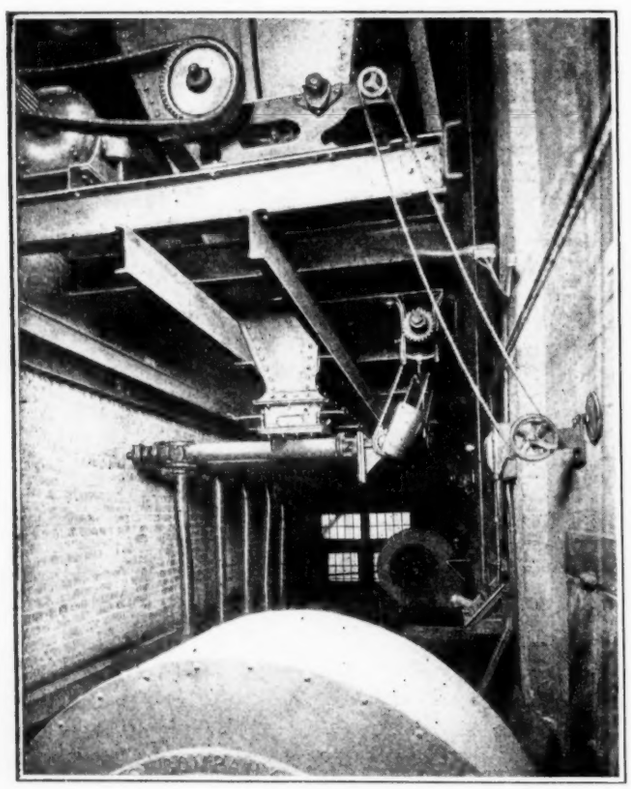


Fig. 1—Close-up view of feeding mechanism

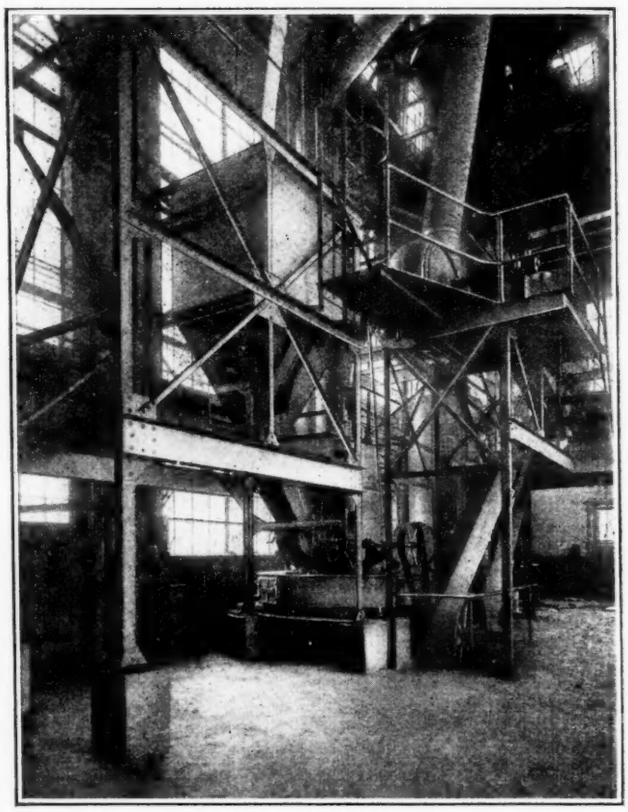


Fig. 2—Preparation plant with 5-ton mill in foreground

When it came to selecting the boiler, it was the desire to obtain one with the greatest possible exposure of tube surface to the fire in order to hold down the furnace temperature and save the brickwork and to obtain the benefits from the maximum absorption of radiant heat. Apparently, these conditions were met by the semi-vertical, single-pass, Bigelow-Hornsby boiler shown in sectional elevation in Fig. 3. This boiler has 24 elements grouped in four rows, six wide, with the main steam drum and the superheater arranged between them as indicated. The usual economizer section was omitted, as it was anticipated that the boiler would operate at moderate ratings up to 200 per cent and that uptake temperatures would be comparatively low. In the superheater test given in Table I it will be seen

that this forecast was vindicated, for with operation at 121 per cent of rating, the flue-gas temperature averaged only 426 deg., which was 20 deg. below the average temperature of the steam leaving the superheater. The boiler contains an aggregate of 7,600 sq.ft. At the top of the furnace is a suspended Detrick arch and the furnace bottom, consisting of 9 in. of firebrick standing on end on top of a concrete base, is covered with 4 in. of sand to prevent adherence of clinker. The furnace is of Fuller-Lehigh design and is furnished

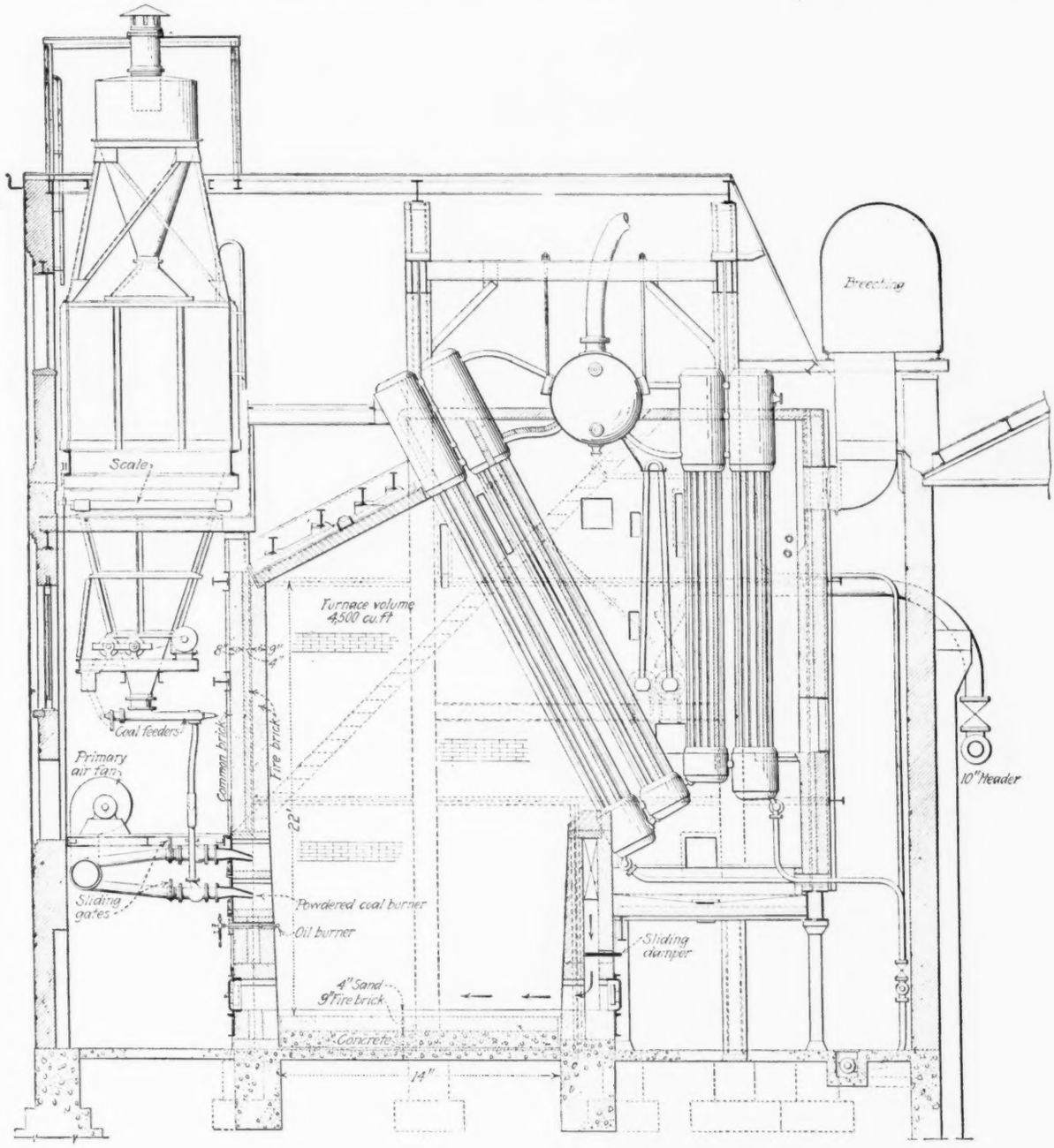


Fig. 3—Section elevation through boiler and setting

of steam-making surface. It was intended to operate at a pressure of 125 lb. gage and superheat approximating 100 deg. at 200 per cent of rating. These conditions were imposed by the steam hammers in the shop, which constitute a large part of the steam load.

A furnace volume of 4,500 cu.ft. was provided, which is an allowance of 0.6 cu.ft. per square foot of steam-making surface. At the front wall the furnace has a height of 22 ft. and a depth of 14 ft. to the bridge wall. Solid walls made up of 8 in. of common brick and 13 in. of firebrick, and stiffened by buckstays, were used. with feeding and burning equipment of this company's make. A feature is the use of five horizontal burners of the horizontal, flared type, staggered.

Powdered coal from the overhead bunker is fed to the furnace by five 3-in. screw feeders, each feeder having a chain drive from a common shaft and a clutch to throw it in or out of service. This shaft is driven by either one of two 5-hp. constant-speed induction motors through a variable-speed Reeves drive. Adjustment of this drive is made by means of a chain and handwheel within reach of the operating floor. This ar-

rangement gives flexibility in operation and reserve to guard against shutdowns.

From the feeders the pulverized coal drops down through vertical risers to the mixing tees ahead of the burners. To take care of expansion, flexible couplings are provided in the risers. At the mixing tees the primary air for combustion is introduced from the main fan duct and the mixture of coal and air is blown through the flared burners into the furnace. The air pressure in the main duct does not exceed 3 oz.. The air is supplied by either one of two Clarage fans of 5,000 cu.ft. per min. capacity, driven by 10 hp. constant-speed induction motors. The amount of air entering

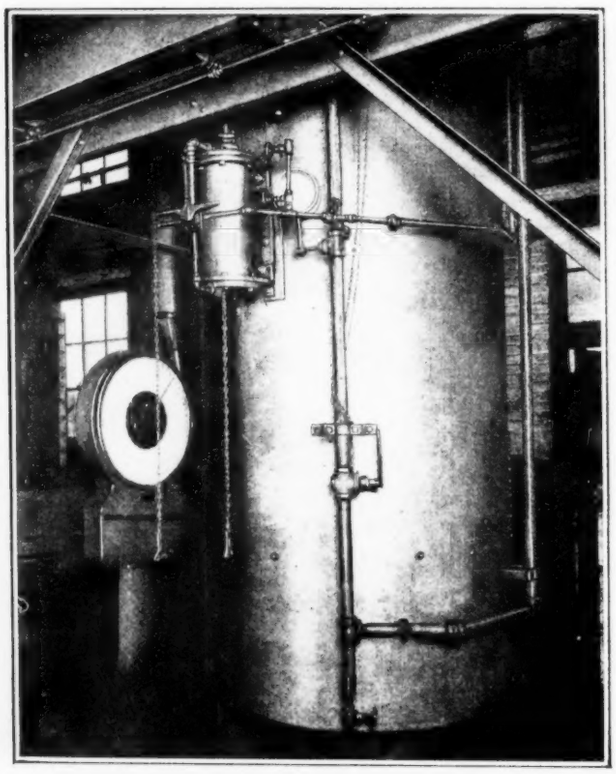


Fig. 4—Powdered-coal transfer tank and scale

each burner is regulated by a hand-operated slide valve ahead of the mixing tee.

About 30 per cent of the total air for combustion is supplied by these fans. The secondary air has access to the furnace at various points, part of it entering through adjustable openings around the burners and through registers in eight ash doors arranged front and back at the bottom of the furnace, and a considerable portion that is slightly preheated through a hollow bridge wall. Through openings in either side of the setting, the air enters the top portion of the hollow bridge wall, the space being partitioned off at the center with four sliding dampers to regulate the admission of the air into the furnace. Being at a lower temperature than the gases of combustion, the air from the bridge wall sweeps entirely across the bottom of the furnace and keeps the temperature below the slagging point. A Shallcross control is employed to maintain a draft of 0.2 in. 7 ft. above the furnace bottom.

During the month of August the average evaporation per pound of coal fired ran slightly in excess of 11 lb. of water, and for two weeks in September the Venturi meter indicated an average evaporation of 11½ lb. of water. These figures are approximate, but indications are that an over-all economy in the vicinity of 80 per cent is maintained.

Representative coal analyses are given in Table II, particularly those made on July 16, as the coal analyzed on July 29 shows more ash than usual. The coal is pulverized to a fineness, so that 99 per cent passes through a 48-mesh screen, 94 per cent through a 100-mesh screen and 76 per cent through a 200-mesh screen. As to savings effected, practically the same load is being carried by 15 tons of coal a day as compared to 30 tons required in the older plant. In addition, the services of two men have been eliminated.

TABLE I—RECORD OF TEST ON FOSTER SUPERHEATER

	Time	Steam Pressure, Lb. Gage	Steam Temp., Deg. F.	Superheat, Deg. F.	Flue-Gas Temp., Deg. F.	Rating, Lb. Water
1	8:20	110	430	..	410	25,000
2	8:30	115	442	..	410	27,000
3	8:40	125	428	..	415	26,000
4	8:50	125	466	..	420	27,000
5	9:00	120	458	..	420	26,000
6	9:10	118	452	..	420	26,000
7	9:20	120	446	..	420	27,000
8	9:30	125	440	..	423	27,000
9	9:40	120	450	..	425	27,000
10	9:50	110	450	..	424	26,000
11	10:00	110	448	..	423	26,000
12	10:05	120	438	..	425	25,000
13	10:15	124	446	..	430	30,000
14	10:20	123	456	..	435	31,000
15	10:25	117	450	..	432	30,000
16	10:30	123	448	..	432	30,000
17	10:35	125	458	..	432	30,000
18	10:40	120	430	..	443	31,000
19	10:45	125	433	..	446	31,000
Average		120	446	96	426	27,789 or 1.21 per cent

It is the usual practice to operate the boiler only through the day shift and shut down for the night, with all air inlets closed to retain as much of the heat as possible. When starting up in the morning, the method of igniting the fuel is as follows: A gas burner, similar to a bunsen burner, which is attached to the gas supply through a flexible rubber hose, is placed inside the furnace. It produces an intense flame about 5 ft. long, which readily ignites the coal as soon as it is turned on. About one-half hour is taken to bring up the pressure with only three burners operating.

Having outlined the boiler end of the installation, it may be of interest to trace the coal through the preparation plant, which had been provided some time ago, first to supply powdered coal to the industrial furnaces and later to the new boiler. The accompanying photographs indicate the general arrangement and the type of equipment employed.

TABLE II—REPRESENTATIVE ANALYSES OF KENTUCKY COAL BURNED AT THE PLANT

Test made.....	July 16, 1925		July 16, 1925		July 29, 1925		July 29, 1925	
	As Rec'd	Dry	As Rec'd	Dry	As Rec'd	Dry	As Rec'd	Dry
Moisture.....	2.71	.....	2.20	.....	2.82	.....	2.05	.....
Ash.....	5.97	6.14	6.68	6.83	10.13	10.42	11.97	12.22
Volatile.....	37.71	36.70	35.05	35.84	32.82	35.77	31.87	32.54
Fix. carb.....	55.61	57.16	56.07	57.33	54.23	55.81	54.11	55.24
B.t.u.....	13,781	14,165	13,644	13,951	13,112	13,493	12,855	13,124
Sulphur.....	0.81	0.83	0.67	0.69	0.81	0.83	0.98	1.00

A grab bucket operating on a monorail unloads the cars of coal as they arrive and either places the fuel in open storage or into the raw-coal bin of the preparation plant. The monorail also extends to the boiler room for delivery of coal to the stoker-fired reserve units.

From the bottom of the receiving bin the coal is carried by a plate feeder to a single-roll Jeffrey crusher which discharges to an elevator carrying the coal to the top of the fuel-preparation building. Here it is transferred to a belt conveyor and after passing over a magnetic pulley, enters a large overhead storage bin. From storage, delivery is made as required by a plate

TABLE III—RULES FOR THE SAFE OPERATION OF A POWDERED-COAL PLANT

INSTRUCTIONS FOR PULVERIZED FUEL SYSTEM

1. A cloud of fine coal dust is as dangerous as a body of unconfined gas if the dust is liberated where there is a fire or heat which will ignite it.

2. The plant must be kept free from accumulations of finely pulverized coal that might be brought into suspension in the air.

3. Removal of accumulations of pulverized coal should be done in such a manner that none of it will be permitted to get into circulation in the air.

4. Torches or open lights of any kind must not be used in any part of the plant, at any time, whether or not the plant or any part of it is in operation.

5. Smoking is entirely prohibited at all times.

6. Pulverized coal must not be permitted to remain in a packed or caked condition within piping or containers.

7. At any time when combustion is in progress or the temperature of coal within a storage bin is about 180 deg. F., a fresh supply of coal must not be added. Coal in the bin must first be removed and the bin cooled to normal temperature.

8. Coal in the transfer line must be entirely blown out each time it is used.

9. Transfer of coal from pulverizer plant to points of consumption must be so positively regulated as to leave no opportunity for filling bins to overflowing. Every precaution must be taken to prevent blowing a surplus of coal beyond the capacity of the storage bin.

10. Pulverized coal must not be admitted in a furnace unless a flame of such proportions as will insure ignition is first placed in the proper position before the burners.

11. Care must be exercised to keep burners open or keep coal from coking in them.

12. Hatch lids on bins must never be opened while coal is entering the bins. They should not be opened unnecessarily and should not be opened except by those properly authorized to do so.

13. Motors must be inspected at intervals for deposits of dust within their casing.

14. There must be no leakage of pulverized coal into the open air.

15. Every joint must be absolutely tight.

16. Don't hold lighted torch or match over manhole in dried-coal bin to see how much coal is in the bin.

17. Don't allow any leaks in the collectors or piping.

18. Whenever the coal in the bin is found to be heating, first see that the manhole frame and cover are tightly closed and then tie a sack tightly over the exit stacks of both the cyclone collector and the vent stacks so as to prevent circulation of air in the bin. Do not use water to quench fires in powdered coal in bulk.

19. Remove by feeding it through bottom; never try to remove burning powdered coal through the top of the bin. If the burning coal cannot be fed into the furnace, then run it slowly out onto the floor, preferably in a bed of sand, and throw sand or other non-inflammable dust on it.

20. Do not stop primary air fans when furnaces are shut down before all the powdered coal in the pipe line has been thoroughly blown out.

21. Never allow a bin to overflow. A careful check on the amount of coal in a bin must first be taken before coal is transported.

22. The man at the bin must notify the operator at powdered-coal plant when the bin is ready to receive coal and the operator at powdered-coal plant must notify man at the bin when he has finished transporting.

23. Manhole covers must be tightly closed before coal is transported.

24. Powdered coal stored in bins or tanks sometimes during ordinary operation catches fire from spontaneous combustion or otherwise. In cases of this kind keep right on drawing it off in its semi-burnt state, cutting off the supply to the bin that is on fire, and burn it until it is all out of the bin; when a new supply may be put in if the bin has not become heated. In the event that the bin has become heated, care must be taken to see that none of the burnt coal remains and that the bin is cooled off before a fresh supply of coal is put in.

25. In case of a temporary shutdown of the plant the bins should be watched for spontaneous combustion. If the coal starts to fire, it should be removed from the bin at once.

26. Whenever a bin or tank is opened for repairs or inspection, the following precautions must be fully observed:

Permit no smoking. Prohibit the use of matches. Use only incandescent electric lights with guards for lighting. These same precautions must be observed in places where particles of coal dust are floating in the air.

27. All electric switches and motors must at all times be kept free from coal dust.

INSTRUCTIONS FOR OPERATOR IN PULVERIZING BUILDING

1. The building must be kept thoroughly ventilated at all seasons of the year when the pulverizing or crushing plant or any part of one is in operation.

2. Cleanliness must be strictly observed, and no accumulation of material of any kind, not necessary for present use and operation, is permitted within any part of the plant.

3. Conveyors or elevators should be kept tightly inclosed at all times.

4. The crushed coal elevator must be running before the crusher is started.

5. The feed to the crusher must be stopped off before the crusher is stopped.

6. Care must be taken not to overload or choke up the large crushed-coal storage bin.

7. Care must be taken not to overload the dried-coal bin over the pulverizer.

8. Careful examination must be made at the magnetic pulley on top of the large crusher coal bin to make sure there is no sparking of the contacts.

9. Don't run the pulverizer a moment if the exhauster fan stops.

10. Don't allow the pulverizer to run empty. See that the feeder is always working.

11. Inspect all parts of preparation plant at regular intervals and see that no coal dust is allowed to collect on building steelwork, platforms, bin covers, etc. Cleanliness is the best preventive of fires and dangerous conditions.

INSTRUCTIONS FOR PULVERIZED FUEL SYSTEM DRIER

1. The temperature of the coal within the drier and after leaving it must be perfectly controlled, and pulverized coal must not be stored when at temperatures higher than 150 deg. F.

2. If the drier is to be stopped for any considerable period of time, or if the drier should unavoidably be stopped and it is evident the delay will be five minutes or more, should the drier in either case contain coal—heat from the furnace must be entirely shut off and diverted through the stack so that none can enter the drier.

3. When starting a fire in the drier furnace, paper or other light material that might be drawn by the draft into the drier, must not be used for lighting.

4. The drier must be rotating before coal is fed into it and must continue rotating after the feed has been shut off and until all the coal in the drier is discharged.

5. The dried-coal elevator must be operating to receive the coal fed through the drier.

6. Don't have a fire in the drier large enough to set fire to the coal. It is the large quantity of warm air that removes the moisture instead of a big fire. The coal, as it leaves the drier, should be just hot enough so that it cannot be held in your bare hand.

7. The feed and fire for drier should be as uniform as possible, and if it is necessary to stop the feed, the firedoors should be opened, or preferably the fan stopped; otherwise the inner shell would become overheated, and continual abuse of this kind would result in its destruction.

8. In some cases better drying results are obtained by leaving the ventilators in the firedoors, or the doors themselves slightly open, permitting a large quantity of air to be drawn over the drying material.

9. Keep the fire in the drier firebox pushed well back from the door, leaving about 18 in. of the grate bars bare so as to allow the excess air required to be drawn up through the grates from the ash doors. This will give a cooler and more effective fire. Auxiliary stack damper must be opened before a fire is started in the drier and remain open until drier and exhauster are running at normal speed. Whenever it is necessary to shut down the drier, the auxiliary stack damper must be opened at once; preferably before stopping the drier.

10. Test the drying coal by feeling it with the hand. This can be done through the inspection handhole on the drier discharge head. When the coal is properly dried, it will be just too hot to remain on the operator's hand and will not feel steamy. When the hand feels steamy, the coal is not properly dried, no matter how hot it is.

11. When the coal is being discharged hot and steamy, it indicates too hot a fire without sufficient excess air. To remedy, push the fire back from the door and allow more air to be drawn through both ashpit and firedoors, if necessary.

12. When the coal is being discharged cold and steamy, it is usually a sign of over-feeding. To remedy, usually it is necessary only to slow down the feeder or partly close the gate at the bottom of crushed-coal bin.

13. Do not store dried coal in the dried-coal bin for longer periods than one hour, as coal in this state is more subject to fires than at any other time. When shutting down the pulverizer, always stop the drier first. Do not open elevators while they are lifting coal except in an emergency, and then only hand flash lamps should be used for light.

feeder to a 5-ton hand-fired Ruggles-Coles rotary drier where a limited amount of moisture is taken from the coal. Leaving the drier at an average temperature of 200 deg. F., the coal is transferred in a bucket elevator to a three-ton supply bin for the pulverizing mill, which is of the Raymond high-side type having a capacity of 5 tons per hour. From the mill the pulverized fuel passes to a cyclone separator to be discharged into a 5-ton storage bin for delivery to a 3-ton air-tight transfer tank mounted on an indicating scale, from which it is forced out by compressed air to a 40-ton receiving tank or bunker in the power house, about 300 ft. away, through a 4-in. pipe at the rate of about 1½ tons per minute. An air pressure of 40 lb. is used for this work. The tank and scale are shown in Fig. 4.

When the original investigation was being made, it was discovered that considerable risk was involved in the method of checking the amount of coal in storage in the various receiving bins. Hence J. H. Taylor, president of the American Spiral Pipe Works, developed a method of carrying each of the various receiving tanks on a hydraulic diaphragm support which is calibrated and indicates accurately at all times the amount of coal in the bin. By means of a pipe connected between two indicating gages, the fuel weight is shown both at the bin and at the preparation plant, so that the operator who is delivering the coal can prevent any overflow of the receiving bins. This ingenious arrangement eliminates one of the most serious hazards commonly found in powdered-coal installations.

Handling Oil-Fired Water-Tube Boilers

By George H. Briggs *

ONE of the problems encountered in operating oil-burning boilers is that of proper air regulation. In fact, in most plants little if any attempt is made to adjust the dampers to obtain the best efficiency.

In one Pacific Coast stand-by plant the 5,000-sq.ft. boilers burn oil, using steam-atomizing burners. They are equipped with an upper and a lower damper operated separately to control the natural draft used. Each boiler is also equipped with a draft gage, pressure gage, smoke detector and a steam-flow-air-flow meter.

The boilers are subject to a range of from 40 to 250 per cent rating and the real problem is that of getting the maximum furnace efficiency at all ratings with no smoke. A high furnace efficiency is attained when there is just enough surplus air to make complete combustion possible. Of course in some plants attempting to hold down the excess air there is a great loss due to insufficient air, but this plant, having smoke detectors, does not experience this loss.

The air entering the furnace comes from two sources: The primary air supply is that which flows through the checkerwork, while the secondary air supply is that which is admitted to the furnace above the fire through the front doors and through leaks in the boiler settings. There is likely to be a considerable infiltration of air under even the best conditions, so too much care cannot be given to the stopping of these air leaks.

As a rule the duty of keeping settings plastered and the air cracks filled is outside the jurisdiction of the firemen and becomes everybody's duty and nobody's job. Very good results have been obtained by holding the men responsible for the air leaks in the settings.

Another defect that leads to excess air, also smoke and in turn, low furnace efficiency, is dirty burners. As a rule the burners are kept in good condition because one man is held responsible and as soon as a burner starts to get dirty, it is taken out of the service. Considerable oil can be lost by keeping a dirty burner on the line.

A five-burner arrangement was found to give about 20 per cent more rating than a three-burner arrangement. It is readily seen that by raising the rating on all boilers by this means, the stand-by losses can be cut, owing to the fact that so many boilers do not have to be kept hot.

In addition to having enough air for combustion, the air must be in the right place in order to attain maximum furnace efficiency. This is accomplished by the proper checker-brick arrangement.

Damper Control

After proper attention has been given to settings, burners and checkerwork, the only other method we have to control the air is by means of the dampers. This is entirely up to the firemen and calls for constant attention to the fires and to the dampers, as these regulate the losses up the stack.

The boilers are equipped with a damper in the ashpit and also a damper in the breeching. These are operated separately by means of a handwheel with a ratchet arrangement in order that close regulation may be attained. To add to the simplicity of the arrangement, the fireman can stand in one position and adjust these two dampers, observing the smoke detector, draft gage and steam-flow meter.

There is a proper relation between the openings of these two dampers which can easily be determined. If the bottom damper is open too much, there will be a tendency to build up a pressure draft at the top of the first pass, which is about +0.03 in. of water at the low ratings. As this is more than atmospheric, the gases, and smoke, if any, will be forced out through the small leaks around the front of the boilers, instead of out through the breeching, thus filling the boiler room full of smoke. At times smoke may be seen coming from these leaks, although no smoke shows in the breeching.

If the bottom damper is closed too much, the main source of air is shut off. This produces high draft in the top of the third pass and also in the top of the first pass, owing to the existing draft in the stack; that is, there is plenty of available draft but very little air flow. Some air will be drawn in through the air leaks in the setting, but very little of this air will be in the right place to help combustion. The high draft readings shown on the draft gage, especially at the lower ratings, are confusing to some of the firemen because they have become accustomed to looking upon the draft gage as an instrument which represents the amount of air flow instead of a pressure gage which represents the pressure below that in the boiler room or the draft at the particular point where the draft gage is connected. As an example the draft gage might show a draft sufficient for about 200 per cent rating, while in reality the air flow is good for only about 75 per cent rating.

*Pacific Gas & Electric Company.

What is really wanted is draft or below-atmospheric pressure in the top of the first pass instead of above-atmospheric pressure, and this draft as low as possible. In addition the pressure drop through the boiler should be as low as possible.

The following method of operating these dampers is very satisfactory:

First: Adjust the lower damper in order to get the draft in the first pass as low as possible. At the lower ratings it is best to open the damper wide enough so gases can be seen coming through the small air leaks in the front of the boiler. This indicates pressure. Then close the damper gradually until the gases disappear. After this damper is adjusted, the upper damper can be changed until the smoke detector shows smoke appearing. It may now be necessary to adjust the lower damper again slightly for closer regulation. The positions of the dampers change with the different ratings, but the firemen soon become familiar with this relation.

With the draft gage connected to the top of the first pass and also to the top of the third pass, the drop between these two points will be the difference between these two readings. The chimney action, or static head of the hot gases at no flow, remains fairly constant while the differential pressure due to flow varies with the load. Therefore by keeping this differential down, the flow of air is kept down.

The regulation of the dampers is still more simplified by the use of the steam-flow-air-flow meter owing to the fact that this instrument records the differential pressure drop due to air flow.

Tightening Loose Armature Bearings

Where motors are geared to their loads, there is always danger of a bearing working loose in its housing. After a bearing has become loose, if it is left in this condition the outside of the sleeve is not only rapidly worn, but the seat in the housing is also worn. This makes it impossible to fit a new bearing of standard size. If the bearing becomes loose, it is best to replace it with a new one properly fitted on the housing. Not being properly fitted when first installed is one of the common causes of bearings becoming loose.

Where motors are properly lined up and directly connected to their load, or the drive is through a belt, there is little chance of the bearing becoming loose. Bearing fits that may be entirely satisfactory on direct or belt drive, may work loose and cause trouble on gear drive in a short time, owing to the vibration set up in the motor shaft, especially if the gears are not properly in line. Where split housings are used, care should be exercised that the bolts do not work loose and let the bearing free in the housing and wear the sleeve too small for its seat. In some cases, where bronze bearings have been allowed to become very hot, they have, on cooling, been found loose in their seats, owing to unequal expansion and contraction of the two metals.

If the bearing in a split housing becomes loose, it generally can be tightened in its seat temporarily by using metal shims of the proper thickness to make a good fit when the housing bolts are tightened. Unless the seat is badly worn in a solid-housing bearing, shims cannot be conveniently applied to tightening a bearing. In this case the bearing sleeve may be tinned with solder and then forced into the seat. Or those portions of the bearing held in the seat may be roughened with a prick punch or cold chisel so as to produce a number of spots on a greater diameter than that of the seat. Then the bearing may be forced into place. This, however, is only a temporary repair and should be used only until a permanent job can be done.

Permanent repairs to loose bearings can be made by building up the bearing seat on the sleeve by welding and then machining to the proper size. Another method is to rebore the bearing seat in the housing and use an over-sized bearing. The seat may be bored out, bushed to the proper size and a new bearing fitted; or the sleeve may be built up to the proper size by welding and then machined to a correct fit. Where babbitted bronze sleeves are only slightly worn in their seats, they have been expanded to a proper fit on a mandril, and then rebabbitted to fit the shaft. This method has less to recommend it than any of the others. Where proper care is given to fitting the bearings and they are kept properly lubricated, little trouble should be experienced with loose bearings, even on gear drives.

Clearing a Separator Without a Trap

By G. Grow

In an Eastern hotel the steam line to the engines was provided with a large separator, inasmuch as the boilers were about 200 ft. from the engines. The trap connected to the separator always gave trouble, and frequently a slug of water got over to the engines.

It was necessary to run a new line to the laundry, and the engineer conceived the idea of discarding the trap mentioned and connecting the 1-in. laundry line into the bottom of the separator. The amount of steam used in the laundry is large, and the steam drop ranges from 10 to 40 lb.

This steam drop is a throttling action and the steam passing along the laundry line would be superheated if it left the separator in a dry saturated condition. The engineer was of the opinion that the throttling action would cause the moisture thrown down in the separator and carried into the laundry line, to be evaporated by reason of the superheat in the steam.

In operation the separator is always dry and, if all the moisture is not actually evaporated, its presence in the steam entering the laundry does no harm.

The use of 1-in. pipe when it is usual to install 2- or 3-in. pipe has its advantages. The loss in heat through the covering is less; the cost of the installation is much less and the pressure drop removes all necessity for a pressure reducing, or control, valve in the laundry.

Many fancy that the use of thermodynamics by engineers engaged in the design and testing of steam machinery is very profound. As a matter of fact, what the engineering profession uses is but a small portion of the entire subject, limited in scope and simplified in treatment. It is the physical chemist whose knowledge of thermodynamics must be exhaustive. While the engineer deals with simple bodies, like water, the chemist must study solutions and mixtures whose behavior is complicated not only by fusion and evaporation, with their heat absorptions, but by changes in composition of solid, liquid and vapor phases, each with a characteristic development or absorption of heat. Of late years the chemist has been developing thermodynamic theory far beyond the present domain of the engineer.

A Study of Combustion Events Taking Place in an Oil Engine*

By DR.-ING. O. MADER

THE combustion space is the most vital part of the internal-combustion engine, and about this point the entire design centers. The dead space ought to be without projections or crevices and should present the minimum amount of surface for heat absorption, as any heat transfer before the expansion is completed, represents a loss and also causes stresses in the cylinder and jacket walls. For this reason the combustion space should be surrounded by the thinnest possible walls containing only small perforations.

In four-stroke-cycle engines the valves in the head are sources of danger. In the two-stroke-cycle engine

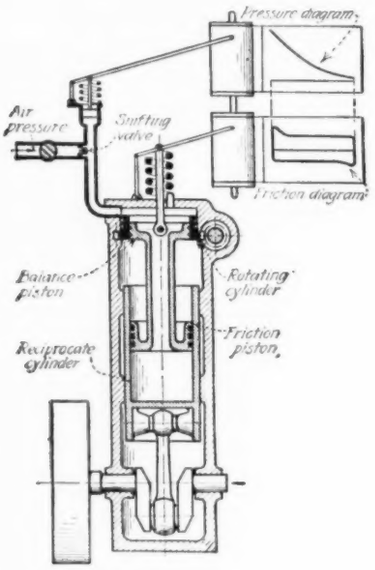


Fig. 1—Apparatus to measure true piston friction

the slots in the cylinder are at points where the temperature is relatively low, and furthermore the solid metal between the slots is usually cooled. The cumbersome and complicated cylinder head and its joints necessary with the four-stroke-cycle engine are also displaced in the two-stroke-cycle.

Scavenging, which usually presents the greatest difficulty in two-stroke-cycle engine operation, is easily taken care of in the double-piston engine such as the Fullager or Doxford. Scavenging here takes place without change in the direction of scavenging air flow.

The question whether a four-stroke-cycle or a two-stroke-cycle engine is preferable is still an open one, but because of its greater simplicity in small engines and because of greater reliability and compactness in large engines, the two-stroke-cycle design is coming into the foreground.

The aim of new designers should be to simplify construction and operation, to increase reliability and to decrease space requirements.

Professor Junkers decided to abandon the idea of building complete engines for experimental purposes. Instead, he constructed experimental machines especially equipped for taking accurate observations. Such machines are more easily changed in their various details than are completed machines.

The piston friction is doubtless one of the principal factors that make up the mechanical losses in the engine. In spite of this little is known of the influence of the ring form, its tension, the amount of cylinder oil, the strength of the oil film, the tightness of the rings and the distribution of pressure over the ring area, etc.

For this reason Professor Junkers built a special testing machine, as shown in Fig. 1. In contrast to the

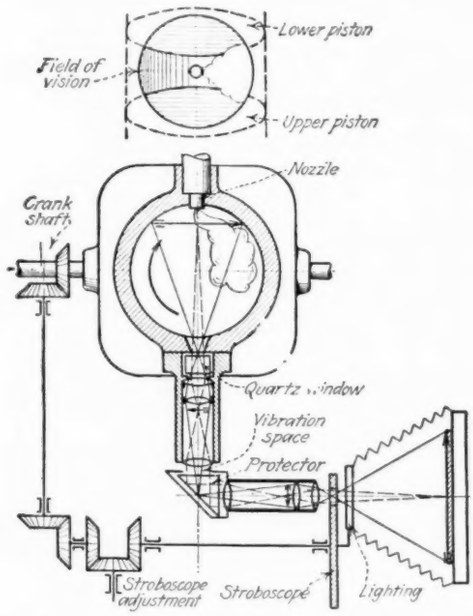


Fig. 2—Device to permit visual observation of flame propagation

actual engine the piston remains stationary and the main cylinder reciprocates, being driven from a crankshaft. With this arrangement it is possible to balance the gas pressure on the piston and also to do away with the friction of the balance piston by the rotation of the balance cylinder. Only the actual piston friction remains and is thus made measurable. Any possible pressure loss by leakage is made up by air pressure entering through the snifting valve, which permits the compression line to be drawn at any desired high pressure.

*Abstract of an article appearing in *Zeitschrift Des Vereines Ingenieure*, Oct. 31, 1925.

The results obtained with this machine reveal the surprising fact that within the limits of the measurements the friction of standard piston rings does not vary appreciably with the pressure, but is approximately proportional to the number of rings employed, whereas double-compression rings that depend partly on the pressure for tightness, show a greater friction variation with changes in pressure.

The usual engine indicators were found to be unreliable in recording high pressure differences and sudden pressure changes, particularly at low pressure, such as during the exhaust and scavenging periods. A special indicator was developed by Doctor Gasterstaedt, which drew records by making a series of dots. An adjustable pressure that may be set at any point is compared with the pressure that is sought, by the making or breaking of an electric contact.

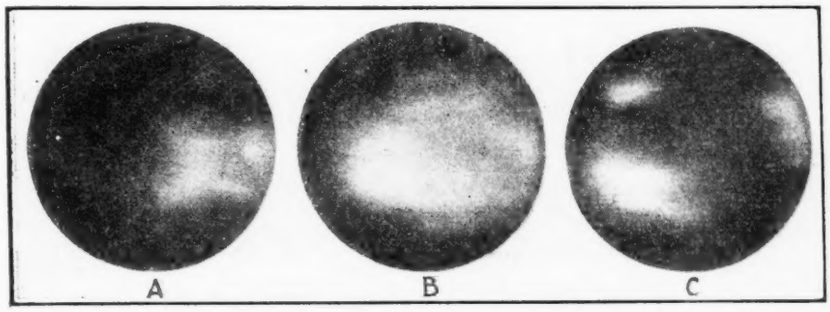


Fig. 3—Appearance of the travel of the flame in the cylinder

Heretofore it has been impossible to observe the combustion process within the cylinder. To make this possible, a special optical instrument was designed. This is shown schematically in Fig. 2.

It was necessary to reveal optically a sufficiently wide area of the combustion chamber through a transparent substance that could withstand pressure up to 900 lb. per sq.in. and temperatures as high as 2,700 deg. F., at the same time insuring the safety of the observer. The shutter had to function to throw light into the cylinder when the crank passed through the desired small arc. This performance was essential to secure clear photographs when the engine ran at full speed. Special photographic plates were also necessary.

With this apparatus it became possible to photograph the flame in front of the injection nozzle for each degree variation in the crank angle, with the engine operating at full speed. Unfortunately, the color of the flame could not be photographed, but nevertheless Fig. 3 shows the flame formation.

To present the foregoing more clearly, the piston bottoms are sketched in perspective at the top of Fig. 2 about as they appear through the sight of the apparatus. The small circle in the center shows the location of the fuel nozzle, while the large circle covers the area of the field of vision. The full load pictures at *A* and *B* in Fig. 3 were taken with the crank very nearly at dead center, shortly after the ignition began. The small quantity of injected fuel has been blown to the right of the nozzle by the compressed air, circulating between the two piston bottoms. At the extreme right of this fuel cloud ignition has just started, as shown in *A*. The cloud then ignites rapidly to the left, toward the nozzle, producing a rapidly spreading flame, as shown in *B*. The very rapid initial spreading of the flame changed its contour so rapidly as to make it appear indistinct.

Much clearer flame edges are shown at *C* during the expansion. Here the flame has practically circulated with the compressed air, and the latter has broken the mass into several smaller flame parts.

A directly driven pump, which has no valve gear, injects the fuel through atomizing nozzles into the cylinder. Tangentially inclined slots admit the scavenging air and impart a rotary motion within the cylindrical combustion chamber. This whirling motion is at least partly maintained during compression, as it meets with no resistance until injection starts. This fact is established by many observations of the dead space.

Most of the air for combustion is located near the cylinder walls. Owing to the whirling motion this air passes across the injection nozzle that is located on the sides of the cylinder. It is of course necessary that the quantities of fuel and air be properly proportioned. While for small-diameter cylinders and moderate rotative speeds, one nozzle is sufficient, for larger opposed-piston cylinders a number of radially mounted nozzles are necessary. These permit the rotating air to be utilized with even greater effectiveness, without requiring a higher rotative speed or an increased scavenging air pressure.

A Turbine That Has Paid for Itself

A turbine generator of the extraction type is used by the Northern Paper Mills, Green Bay, Wis., for generating some electricity needed in the plant and also for furnishing low-pressure extracted steam for process work and heating. This equipment, installed three years ago, is a 2,000-kw. G. E. machine. When operating straight condensing, the cost per kilowatt-hour is $0.0077, and when 7,500 lb. of steam per hour are being extracted, the cost is $0.0062. Over a possible installation of a straight condensing-type turbine, to carry the electrical load handled by the present unit and the use of live steam for heating and bleaching, $11,467 is saved annually.

Based on this, it is estimated that the turbine installation has saved the paper company, over the current price of purchased power, better than $100,000 since installation, and the total saving due directly to the installation of the generating equipment has exceeded the original cost of the installation, including all foundations, buildings, piping, equipment and the changing of approximately 250 motors from 25 cycles to 60 cycles at the time of the installation of the power unit.

Miscellaneous Publication No. 71 of the United States Bureau of Standards (price 10 cents) contains large-scale graphs for computing the compressibilities of air, argon, helium, hydrogen, methane, neon, nitrogen and oxygen and for computing the volumes delivered from cylinders containing argon, helium, hydrogen, nitrogen and oxygen at high pressures.

Tendencies in Electric-Motor Control Installations

By J. ELMER HOUSLEY
Electrical Engineer Aluminum Company of America, Alcoa, Tenn.

ATTENTION is called to practices that should be avoided in controller installations and examples are given of methods for mounting motor-control apparatus that make for flexibility and safety in operation and maintenance.

THOSE who have followed the development in the methods of installing motor-control apparatus have witnessed as many improvements as will be found in the apparatus itself. These changes have come about gradually and apparently have been quickly adopted by many plants. Where new installations are infrequently made, a problem is presented in planning the various details of the job because of the frequent changes in control equipment.

Induction-motor starting equipment in the early days consisted of an open knife switch fastened to a wood partition, but as the size of motors increased, the starting compensator with switch contacts under oil was added. Later, various schemes were adopted to protect against accidental contact with the deadly open knife switch, and afterward, as fire-prevention methods came into vogue, a complete metallic construction was provided. At the present time the switches are universally

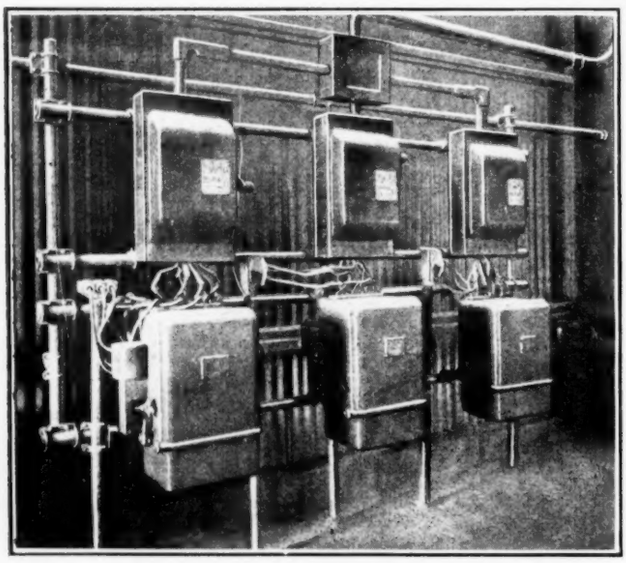


Fig. 1—Pipe-frame mounting with three induction-motor safety switches and compensators

Any of the switches or compensators can be removed without interfering with any of the other circuits. The equipment can be easily inspected and the oil pots removed from the compensators.

installed in a steel box externally operated with a quick-make-and-break mechanism to prevent faulty and careless operation of the switch. The operation often is further safeguarded by devices that prevent the switch door being opened while the switch is closed and likewise prevent the switch being operated while the door is open.

The mounting of this equipment is of permanent importance, and the initial cost may be spent several times in expensive alterations if all details are not carefully considered.

The consideration of safety should be given first place. All apparatus and mountings should be carefully grounded. The location of the mounting should be

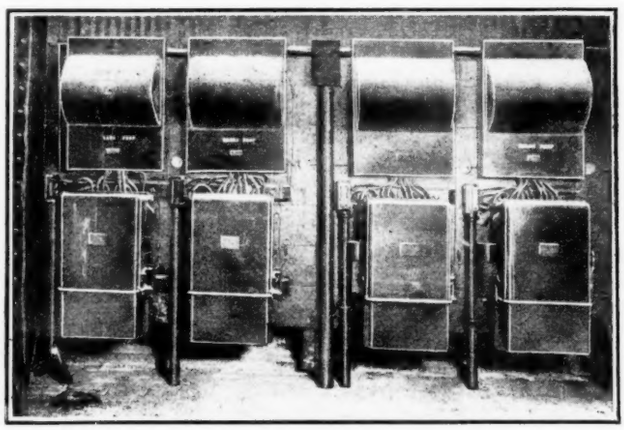


Fig. 2—Bad example of induction-motor starting-equipment installation

Control equipment is mounted on boards, oil pots are too close to the floor and too close to the boards. The inside switches cannot be removed without killing the circuit and disturbing the wiring of the outside switches.

selected so as to involve a minimum of external hazards, such as swinging crane loads, trucks and leaky pipes. The location should be within sight of the equipment operated wherever possible in order to protect the operators and equipment.

Fire risk involved with electrical apparatus is not great, but to protect against any possibility of fire originating from control apparatus the mounting should not use any wood whatever. The spacing from the walls should be sufficient to avoid the possibility of arcs or overheated equipment setting fire to surrounding partitions or material.

The greater the convenience and ease of operation of equipment the better the care it will be given by the operators. A substantial and workmanlike job inspires confidence, whereas a makeshift arrangement will be handled as such. The height of the starting handle and height of the safety-switch handle should be convenient to reach. The spacing of switches should be sufficient to prevent the operator bruising his knuckles every time the switch is operated. Ample room for full opening of switch doors is essential to permit room for testing fuses and motor circuits in case of trouble. Where the illumination intensity in the building is not high, the operation of control apparatus is greatly facilitated by painting the switches

and supports with aluminum paint, which renders the outline of the equipment visible with the lowest practicable illumination and at the same time offers excellent protection to the metal parts. Motor starters equipped with oil pans should be mounted at a sufficient height above the floor to permit the removal of oil pans for inspection and cleaning of parts. Where the starter is mounted too close to the wall, it is difficult

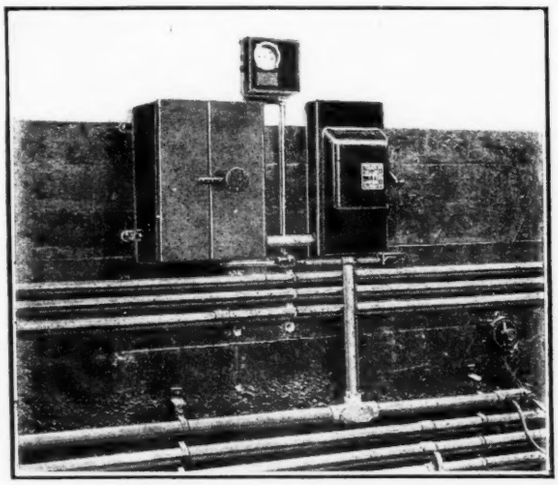


Fig. 3—Control for 40-hp. direct-current motor on governor pressure pump

to repair and replace the switch contacts. Where the apparatus is mounted about eight or ten inches from the wall, maintenance will be improved and conduits may be brought into the rear of the starter and switch and the wiring given better protection.

Attention should be devoted to providing means for readily replacing portions of the apparatus and structure that may be damaged in the course of operation, without dismantling the entire assembly and wiring. Where several switches are grouped, individual feed conduits should be brought into the top of the switch, as in Fig. 1, and not run through the sides of the boxes as a continuous bus wire, as in Fig. 2, since this latter method prevents the removal of an individual box. Where leads are brought into the top, should it become necessary to remove a box, the ends of the leads may be taped and the box slipped out of place without interrupting service to the remainder of the group. Where it is necessary, provision may be easily made to permit additions to the group arrangement as well as changes in switches and control equipment.

In cases of special control apparatus that can be used on but one particular drive, the mounting may be made directly on a concrete or brick wall where such is convenient. Such an arrangement is shown in Fig. 3, which consists of a 200-ampere 2-pole 250-volt safety switch and an automatic lockout direct-current 40-hp. motor starter controlled by a pressure regulator, the drive being on a hydraulic-turbine governor pressure system. For the mounting of the majority of motor-control apparatus such as switches, compensators, drum controllers and resistors, the use of a pipe frame work, made up of 1¦-in. wrought-iron pipe and assembled with switchboard fittings, offers the nearest approach to an ideal mounting arrangement with a universal application to all locations (see Fig. 1). A simple rack may be used for mounting switches and control by using only three types of standard switchboard fittings—the floor flange, pipe cross and single panel support. For a single or double switch and compensator rack, two vertical standards, four crosspieces and two horizontal wall braces may be used, Fig. 4; where additions are desired, they may be coupled on by changing a few U-bolts and adding another set of pipes. The height of the vertical uprights should be about 7 ft., and the width should be sufficient to accommodate the equipment considered. It is a simple matter to slide the cross-member up or down and the panel supports in or out to accommodate various sizes of switches that may be used on different occasions. The bill of material for a single rack is as follows: 2 pieces 1¦-in. pipe 7 ft. long; 4 pieces 1¦-in. pipe 3 ft. 6 in. long; 2 pieces 1¦-in. pipe 1 ft. 6 in. long; 4 No. 5171 1¦-in. 3E pipe floor flanges; 10 No. 5186 1¦-in. 3E pipe crosses; 8 No. 1618 1¦-in. 3E pipe single panel supports.

The pipe-mounting arrangement does not accumulate dirt easily and is readily cleaned and painted, as all parts are accessible. The entire assembly may be made

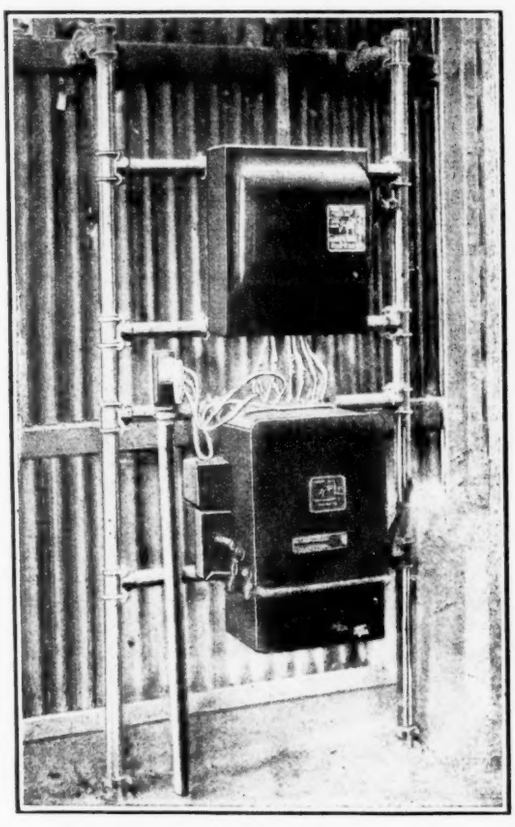
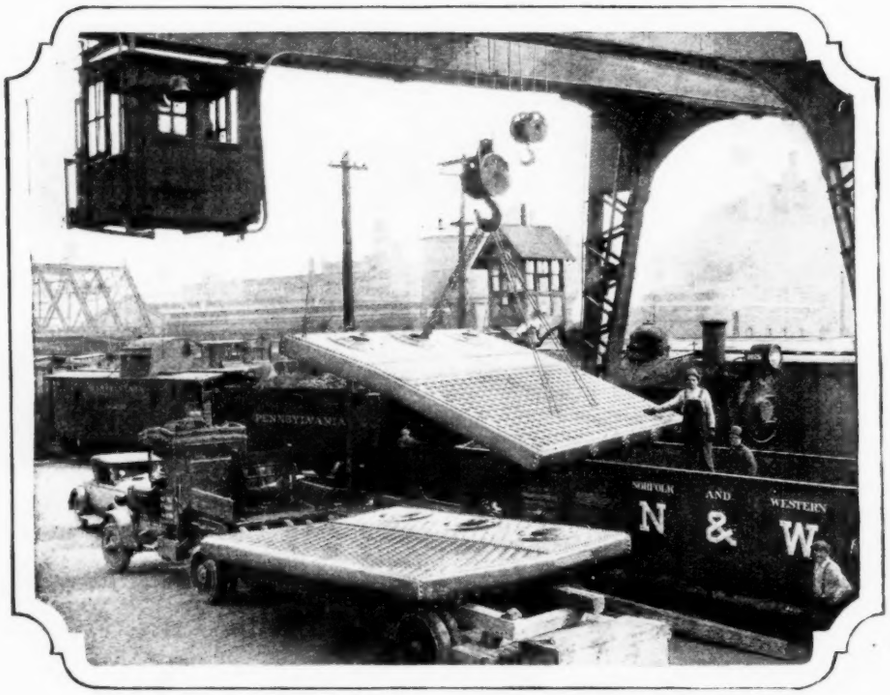


Fig. 4—Safety switch and compensator for induction motor mounted on pipe framework

repaired and fitted in the shop by semi-skilled labor and moved to the job and wired up in the shortest time possible. Should equipment have to be moved, this type of mounting may be adapted to almost any location, thereby extending the life of the mounting almost indefinitely, which is not true where mountings are made up from structural shapes to suit a given location. Owing to the fact that common materials are used and that no machine work is necessary, the cost of the job compares favorably with any other type of mounting.

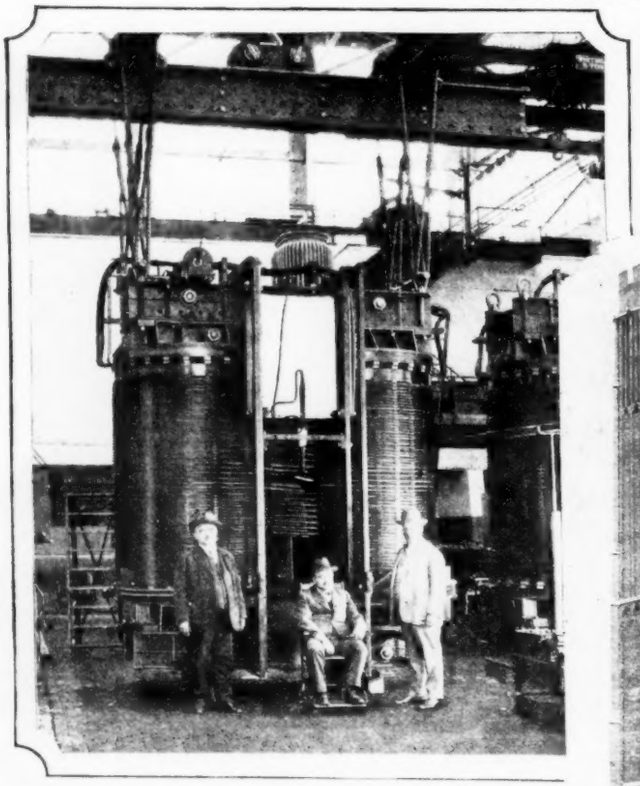


Above—Transferring boilers from the war plant "Old Hickory" near Nashville, Tenn., to a large "loop" hotel in Chicago

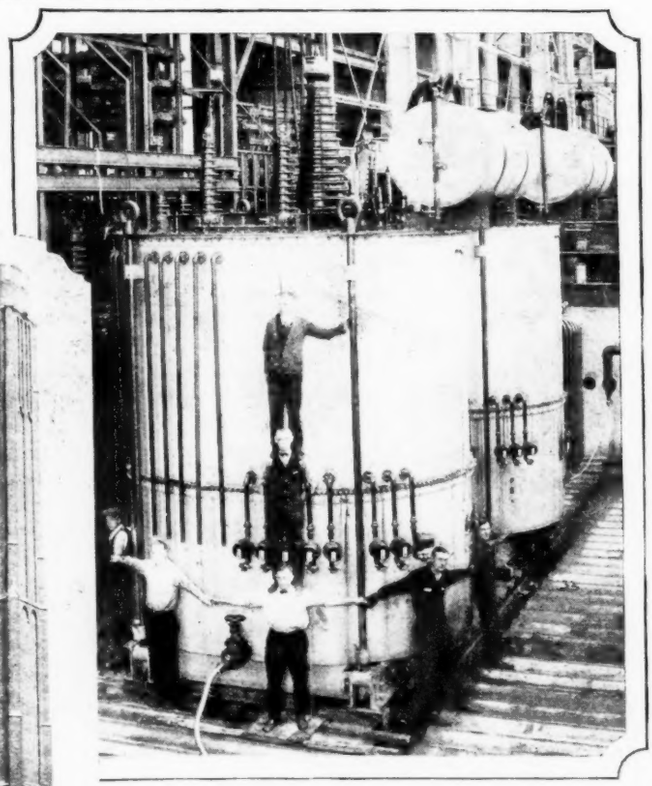
By courtesy of J. F. Davis, Chicago

Center below—This 175-ft. Gothic chimney graces the campus of Washington University, St. Louis

Photograph by courtesy of Wiederholt Construction Company

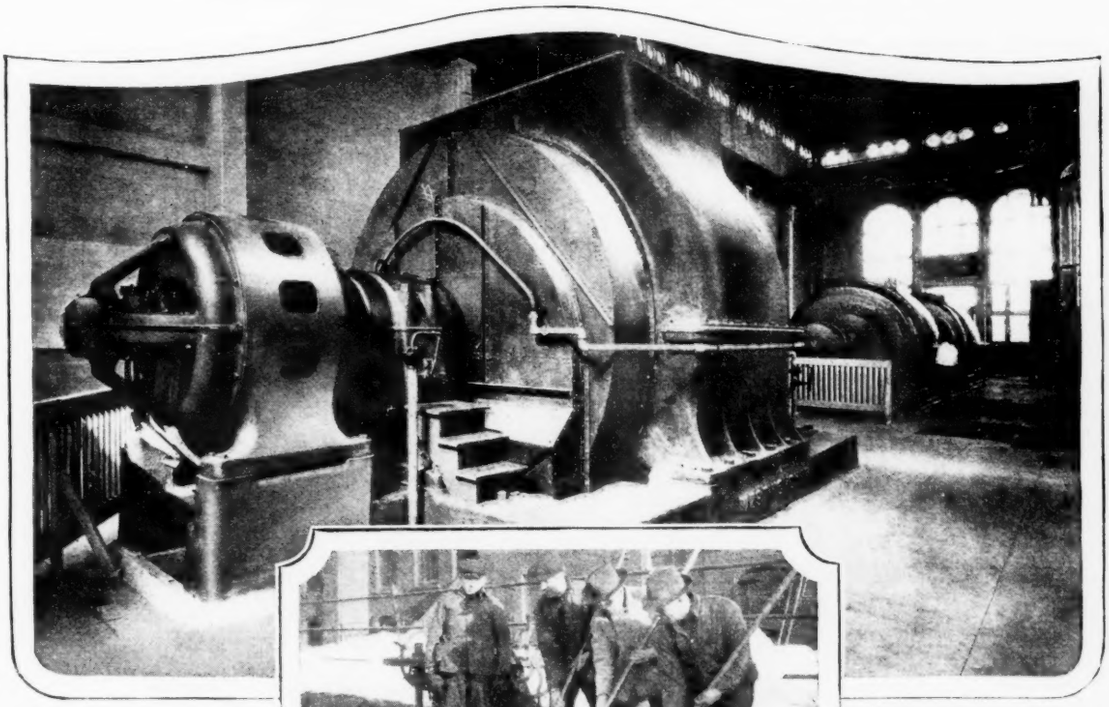


Above—Coil and core of one of four 28,866-kva., 60-cycle, 11,000/220,000-volt single-phase transformers recently built for the Pennsylvania Power and Light Co. These are the largest single-phase transformers yet built



Above—Each of these transformers (see caption on the left) is 24 ft. high, 15½ ft. long and 12½ ft. wide. The total weight of each is 202,000 lb., including 79,000 lb. of oil. Three transformers are to be used in a bank

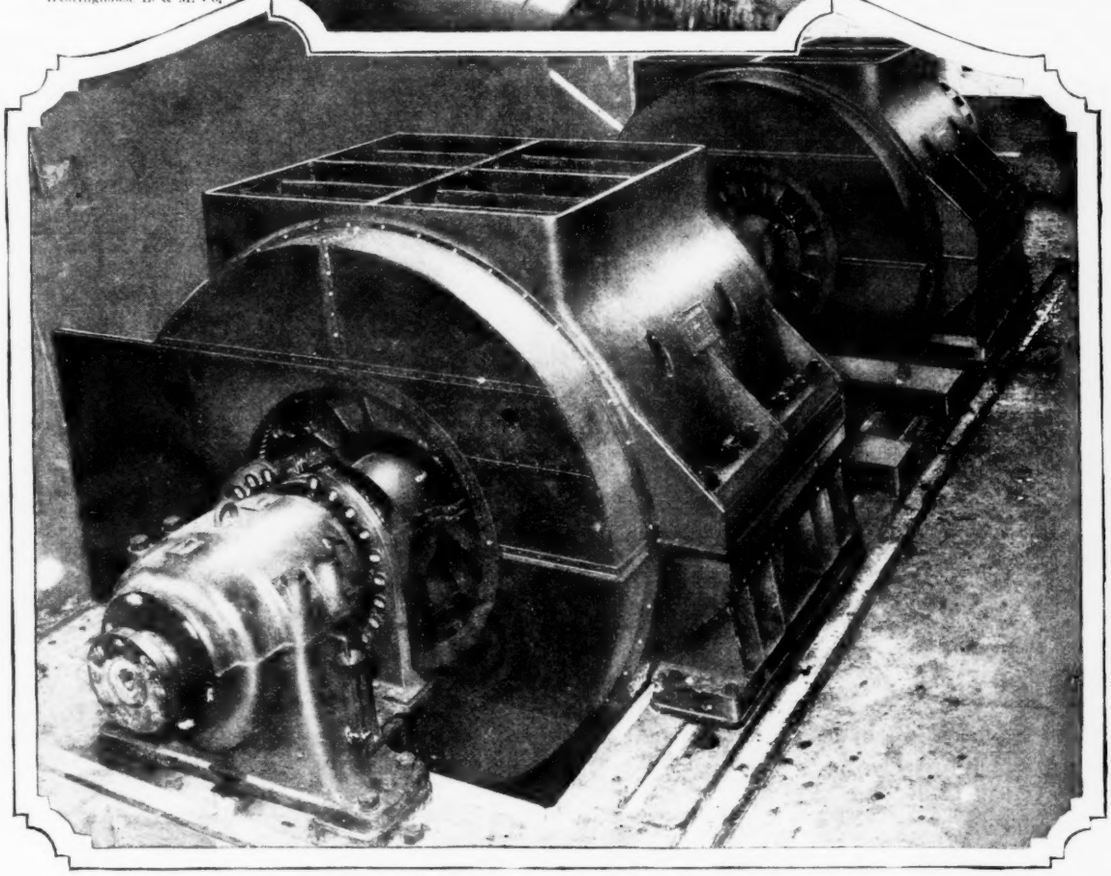
Transformer photos by courtesy of General Electric Company



The 40,000-kva. synchronous condenser shown above is the largest ever built. Below are shown two 20,000-kva. synchronous generators used to test oil circuit breakers, etc.

Photos by courtesy of Westinghouse E. & M. Co.

Left—These "icemen" were snapped at the generating station of the Holyoke Gas and Electric Department on December 30, just after the season's first cold spell. This is the first-level canal



Limits of Refrigerating Plant Efficiency*

By VICTOR J. AZBE
Consulting Engineer, St. Louis, Missouri.

THE efficient operation of a refrigerating power plant depends upon a great number of diversified factors, each exerting a greater or a lesser inflence upon general economy. In this paper are considered only that portion of the plant where power is applied to compress ammonia to produce refrigeration and the factors that determine the range through which ammonia is to be compressed.

WHEN it is stated that the range through which ammonia gas is to be compressed should be the least possible, it means that the condenser pressure should be as low and the suction pressure as high as conditions will permit. If the condenser pressure could be brought down and the suction pressure up to such a point that both are alike, then no power would be required to operate the compressor except that necessary to overcome friction.

To compress the ammonia gas through a 200-lb. range, say from a suction pressure of 20 lb. to a condenser pressure of 220 lb., the brake horsepower required per

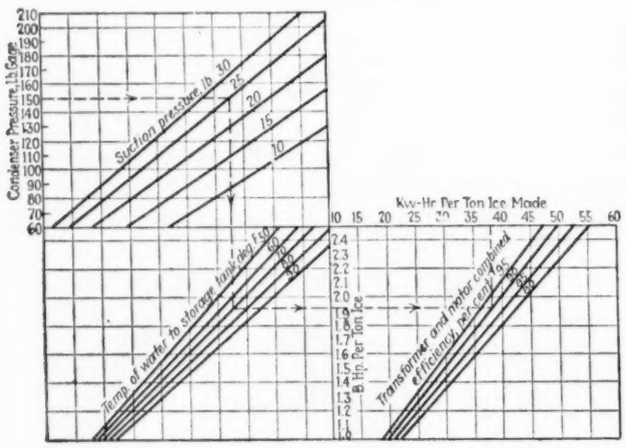

Condenser Pressure, Lb. Gage
Suction Pressure, Lb.
Kw-Hr. Per Ton Ice Made
B.Hp. Per Ton Ice
Temp. of water to storage tank, deg. F.
Transformer and motor combined efficiency, per cent

Fig. 1—Electric power consumption of ammonia compressor per ton of ice made

ton of refrigeration will be about 3.2. For a range of 100 lb., that is, from 20 to 120 lb., the power necessary will be only 1.8 brake horsepower. It will be noticed that more power is required to compress between two stated pressures in the lower ranges than in the higher and that the power is not directly proportional to the range of pressure. In other words, when reducing the condenser pressure at the higher levels, say from 200 to 195 lb., the saving will not be so great as if the reduction in pressure were from 95 to 90 lb. The inverse applies to suction pressure, for the lower the suction pressure the greater will be the gain possible per pound increase in pressure.

Fig. 1 shows the effect of suction pressure, discharge pressure, water temperature and the mechanical effi-

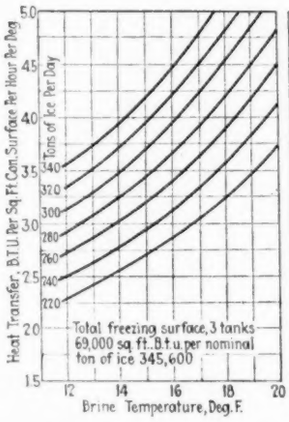

Heat Transfer, B.T.U. Per Sq. Ft. Con. Surface Per Hour Per Deg.
Tons of Ice Per Day
Total freezing surface, 3 tanks—69,000 sq. ft.-B.t.u. per nominal ton of ice 345,600
Brine Temperature, Deg. F.

Fig. 2—Ice can heat transfer

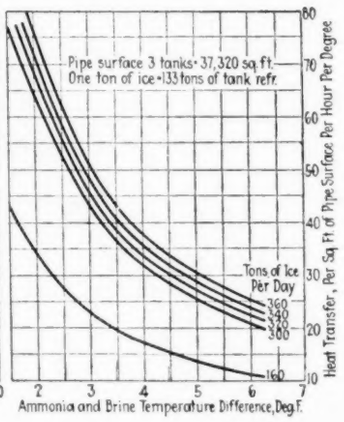

Pipe surface 3 tanks-37,320 sq. ft.—One ton of ice-1.33 tons of tank refr.
Tons of Ice Per Day
Heat Transfer, Per Sq. Ft. of Pipe Surface Per Hour Per Degree
Ammonia and Brine Temperature Difference, Deg. F.

Fig 3—Ice tank pipe heat transfer

ciency of the compressor engine or motor upon the consumption of power per ton of ice. By assuming different conditions and tracing through on the diagram as indicated, the effect on power requirements will be evident.

What condenser pressure may be possible depends first upon atmospheric conditions and second on the cooling-tower performance. The condenser pressure fluctuates with the wet-bulb temperature, but as a rule the condensing temperature will be about 1.4 deg. F. higher.

Efficient Operating Conditions Necessary

To get the results indicated, efficient operating conditions must be assumed. For example, enough water must be pumped over the condenser to hold the temperature range between entering and leaving to five degrees. The condenser must be so efficient that the water leaving it will be only five degrees cooler than the temperature of the condensing ammonia, and the water leaving the cooling tower must be cooled within three or four degrees of the wet-bulb temperature. If all these condition are satisfied, the condenser pressure will be 150 lb. in July in St. Louis. But this pressure may not be obtainable always, as the weather may be warmer than normal, the wet-bulb temperature may rise, the cooling tower may not have enough surface or the wind vary in intensity, so that the condenser pressure may range all the way from 150 to 185 lb., but seldom higher than the latter limit if the plant be properly designed. Pressures higher than those stated

*From a paper read at the sixteenth annual convention of the National Association of Practical Refrigerating Engineers, Detroit, Dec. 9-12, 1925.

may be expected if the quantity of circulating water is limited, if the condenser is of improper design or the surface insufficient, if it contains non-condensible gases or if the cooling tower is of a poor type.

Where there is a fault, it is important to know where to look for the trouble; for example, if in indicating an ammonia compressor and by scaling the indicator diagram, it is found that the discharge pressure is high, there may be one or more causes, such as a large pressure drop through the valves, the discharge line may be too small, there may be considerable friction through the condenser coils, the condenser heat transfer may be low, the water circulation insufficient, the distribution of the water over the cooling tower may be poor, the wind of improper direction, and finally the wet-bulb temperature may be high. It is evident that there are many causes for high discharge pressure in the cylinder.

Turning to the low-pressure end of the system, the suction pressure also is dependent upon a great many

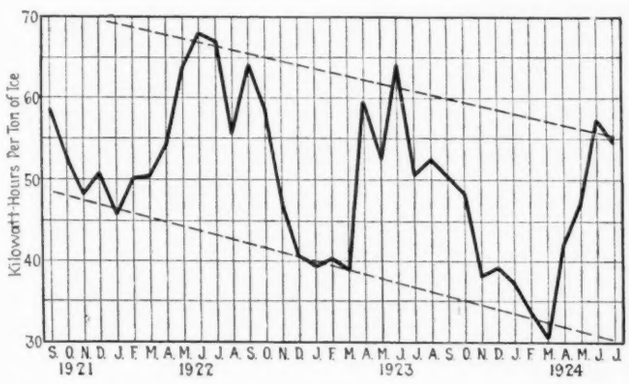


Fig. 4—Improvement in power consumption per ton of ice shown in a certain plant

factors, even if the weather does not exert any particular influence upon it. The quicker the heat transfer can be made from the freezing water to the brine and from the brine to the ammonia pipe, the higher will be the suction pressure. If the heat transfer were so high that no temperature head would be necessary for the heat flow, then the suction pressure in the ammonia pipes would correspond to the freezing-water temperature, or about 47 lb. This, of course, is impossible to obtain, as a definite head is necessary to make the heat flow from the higher level in the ice can to the lower level in the pipe.

Starting with a temperature of 32 deg. in the ice can, the heat given up when water is frozen has to pass first through the ice layers already formed. Unfortunately, ice is a poor conductor of heat, and as the layer the heat has to pass through is rather thick, the temperature difference to insure a heat flow has to be between 10 and 20 deg. In winter, when the rate of ice freezing is low—that is, when the ice cans remain in the tank for a long time—the temperature difference may be only about 10 deg., corresponding to a brine temperature of 22 deg. F. In summer, when the cans remain in the tank for a shorter period, the temperature difference may be as great as 20 deg., requiring a brine temperature of 12 deg. F.

In this connection, there is not much that can be done except to see that the number of cans used is as large as circumstances will permit, and to see that there are no idle cans in the tank. It is important that the can surface be clean, as often an impure salt will cause a soft scale to deposit upon the can surface, which, of course, interferes with the heat transfer.

Fig. 2 shows a chart used by the Merchants Ice & Coal Co., of St. Louis, giving ice can heat transfer. The plant is operated with a brine temperature of 15 deg. F. When making 320 tons of ice, the can heat transfer is about 3.7 B.t.u. per square foot per hour per degree temperature difference. If the equipment is properly operated, the brine temperature can be obtained right from the chart for any other capacity. Thus for 220 tons and the same heat transfer per square foot the brine temperature necessary would be 20 deg. F. The idea back of the diagram is that the higher the brine temperature the higher will be the suction pressure, and such charts are convenient to show the engineer what is being done.

After the heat is delivered into the brine, it must be transferred into the boiling ammonia in the coil. Fortunately, no such great temperature difference is necessary, as there is not the insulation of several inches of ice to penetrate. To minimize the temperature head, however, a large amount of pipe surface is desirable, so that the rapid brine circulation that helped at the surface of the ice can may again help at the coils to sweep away as rapidly as possible particles of cold brine and substitute particles of warm brine.

Pipe Surface Should Be Clean

Here also cleanliness of pipe surface is to be desired. If the pipes are clean and the brine agitation good, the transfer will be high if there is sufficient liquid ammonia in the pipe to take the heat as it penetrates. The heat transfer between a liquid and a solid surface is about forty times greater than between gas and a solid surface. The pipe, however, does not need to be full of liquid. If the surface is wet, that is enough provided the bubbles formed from evaporating ammonia are swept away as soon as formed and substituted with more liquid.

In the Finney Avenue plant of the company referred to, which employs high brine velocities and uses a flooded system, the difference of temperature between the ammonia in the coil and the brine is only 3½ deg. F. when making 320 tons of ice per day and the heat transfer is in excess of 35 B.t.u. per square foot per hour per degree temperature difference. The curves in Fig. 3 give the proper temperature difference for different rates of ice making. For low rates of capacity, the temperature difference is less and the back pressure higher. It might be pointed out that in this plant the pipe surface in three tanks totals 37,320 sq.ft., and that one ton of ice is equivalent to 1.33 tons of tank refrigeration.

After high back pressure is obtained in the ice-tank coils, care must be taken that it is not reduced on the way to the machine, as any reduction in pressure from wiredrawing in the lines or in the valves of the compressor, will have to be made good again by the compressor at the expense of power.

If an engineer studies and continually tries to better conditions, he will get results on the order of those shown in Fig. 4. This chart shows a continuous improvement. In the winter of 1922, 50 kw.-hr. per ton of ice was required. This was reduced to almost 30 kw.-hr. two years later.

Economical Coal Buying

By H. B STANTON

THOUGH coal is not the most expensive of the many materials used by a manufacturing plant, yet in almost every industry a worth-while saving in money could be obtained by the application of more practical and efficient methods to the purchase and use of fuel.

It is true that the small and medium-sized steam plants are the worst offenders against system and economy in their coal-purchasing methods. At the same time the amount of coal consumed by these plants is surprisingly large. A check was made this year of the coal tonnage used by industries in the Central West. It showed that the plants consuming less than 5,000 tons yearly outnumbered the larger ones by more than ten to one. Now the United States Geological Survey gives the annual consumption of coal by manufacturing plants (excepting steel and coke plants) as 139 million net tons, so it is apparent that the actual amount of coal consumed by small and medium-sized industries is not negligible and that economy in these plants will go far toward lowering the nation's yearly coal bill.

THE author, who is connected with one of the large coal companies in the Middle West, points out the shortcomings of purchasing on a heat-unit basis and offers practical suggestions for selecting coal on a performance basis. His recommendations are directed especially to industrial plants.

If any plant is to operate economically, there must be close co-operation between the coal buyer and the men in the boiler room. Even if firemen handle a coal properly, they cannot hope for full economy and the utmost efficiency unless that coal is suited to draft, load and furnace conditions. Conversely, unless the firing and equipment are suited to the fuel, the steam cost will never be minimum.

If these things are true, then little support can be given a system of buying very prevalent today—that of placing the order with the coal firm quoting the lowest price per ton at the mines. It is amazing how many otherwise intelligent men place coal orders on price alone. No raw material but has its different grades and qualities, and coal is emphatically no exception to this rule.

A questionnaire was recently sent to steam-coal buyers in the States of Michigan and Indiana for the purpose of assembling information and publishing it in pamphlet form as an aid to coal selection for industries interested. Data respecting the type of their boiler-room equipment, and the conditions under which coal was consumed, were requested. The answers disclosed some amusing facts. One of the questions asked what kind of coal had been found to give the best results in the plant, the name of the seam and the locality where it was mined. Twenty-five per cent of the answers indicated no special preference. Evidently, all coal looked alike to these men. Fifty per cent answered, "West Virginia or Eastern Kentucky." Now there are fifty-two coal seams mined in the sixteen mining districts of West Virginia and twenty-three seams worked in the twelve districts of eastern Kentucky. No two of these seams are exactly alike, nor does the coal act the same when burned under a steam boiler. About 5 per cent of those answering specified a particular seam, such as the Island Creek, which was more to the point but still too indefinite, for the coal in any seam will vary in quality according to the location in which it is mined. Only a few industries specified the particular mines producing the ideal coal for their use.

These conditions do not prevail because of mediocre business ability on the part of the men buying coal for the smaller industries. On the contrary, they are among the cleverest in the purchase of other commodities. But coal is dirty and most of it looks alike. A boiler room is too often dark, hot and full of soot and coal dust, and the average man finds little there to interest him. Consequently, he will not spend the necessary time in the boiler room to get properly acquainted and so does not realize how profitably such time would be spent.

The chief engineer, if the plant has one, is prone to spend most of his time in the engine room. If he does offer advice on coal, it is sometimes followed, usually with beneficial results. Often it is forgotten when the next chance to buy cheap coal appears. As for the firemen, few of them know how to vary their firing methods to suit the different types of coal, and all fire by rule of thumb. The buyer cannot expect much help from them.

What, then, is a practical method for a buyer to use who cannot spend too much of his time studying up on coal and combustion? Much has been said in favor of the purchase of coal on a B.t.u. basis; that is, requiring the seller to guarantee to deliver so many heat units for each cent of the purchase price, the contract commonly carrying a bonus for an excess of heat units over the required figure and a penalty for a deficit. Often the contract also contains a clause specifying the permissible amounts of ash and sulphur. Here would seem to be an ideal method for, supposing satisfactory operating conditions, the plant that releases the most heat units under its boilers per unit of coal cost will make the cheapest steam.

The leading advocate of this system is the United States Bureau of Mines. It claims the following advantages by its use:

1. All bidders on fuel are put on a competitive basis.
2. The selective field is broadened for both the buyer and the seller.
3. The contract specifies a standard of quality as a basis for price adjustments.
4. If the coal supplied is uniformly poorer than the

standard set, the contract provides a base for cancellation.

5. Since coal quality is greatly dependent on preparation, the knowledge that he is being checked up will make the operator clean the coal more carefully and so furnish a better and more uniform product.

Buying on B.t.u. Basis Rare

These arguments are so reasonable that it would seem that everyone should use this contract. On the contrary, however, the buying of coal on a B.t.u. basis by commercial steam plants is so rare as hardly to be worth mentioning. Evidently, there is something to be said against the practice. Steam buyers who have tried and abandoned the system give the following main reasons for their action:

1. Unavoidable errors in sampling coal.
2. The labor and expense involved in sampling and analyzing coal.
3. Trouble in getting coal companies to bid on a B.t.u. contract, or, if they do, their practice of asking more money for their coal in order to compensate them for possible penalties.
4. The fact that a laboratory proximate analysis does not indicate whether a coal can be burned efficiently under every-day operating conditions.

These objections are well founded. The entire structure of a B.t.u. contract is based on the premise that the thimbleful of coal finally analyzed is representative of the entire shipment consisting of fifty or more tons of coal. If it is not representative, then the analysis cannot be average of the coal supplied, and any penalties or bonuses exacted on the strength of it are unfair.

According to the Bureau of Mines the minimum sample that should be taken from each car of coal (averaging 50 tons) is of 500 lb., and if the coal is in the form of mine run or lump, the sample should weigh 1,000 lb. A medium-sized plant consuming 500 tons a week and buying on a B.t.u. contract, should therefore take a total of two and one-half to five tons a week of samples. They must not only take these samples, but they must crush and mix each sample in an extremely accurate and tedious manner and reduce it to about enough coal to fill two one-quart containers. If the mixing is not carefully done, the quart samples will not represent the original sample and the final analysis will be worthless.

Sampling the Coal Laborious and Tedious

Sampling coal accurately requires much heavy and tedious work, allowing that it can be done accurately at all. Consequently, the taking of coal samples is usually delegated to one of the plant laborers. Experience has shown that this type of sampler is generally content with a few shovelfuls of coal from the top of each car. In spite of the well-known fact that fine coal shakes to the bottom of a railroad car while it is in transit and that the sample to be average must contain a proportionate amount of this small coal, he rarely digs to the bottom of the cars. This is not surprising. Sampling coal properly is a dirty and a heavy job. The average laborer doesn't know what a representative sample or a proximate analysis is, and he won't get any more money no matter what kind of sample he brings in. So one cannot expect him to break his neck getting the samples. Of course the buyer or the chief engineer could supervise him or else take the samples himself, but in view of the time required this would be pretty expensive for the plant.

After the sample is prepared, it must be analyzed. If the industry has a chemist and a laboratory, this can be done there. Chemists and chemical apparatus cost money and take up space, however, and unless the chemist is required for other phases of the business, he would not be a profitable investment. If the sample is sent to a commercial laboratory, the expense ranges from five to eight dollars for each proximate analysis. In a five hundred ton a week plant this means fifty to eighty dollars a week, or from twenty-six hundred to four thousand dollars a year for analyses alone—quite an item to that size steam plant.

Other Weak Points of System

Of course the daily samples can be combined to form one weekly sample, but in this case the analysis would represent ten cars instead of one. If the analysis indicated poor coal and the plant tried to assess a penalty on this basis, it would be found that few coal companies would admit a single sample to be representative of ten cars of coal. The seller would be perfectly justified in claiming that one poor car could spoil the other nine and that he was being penalized on 500 tons of coal when he should only be asked to adjust the price on fifty tons.

Another bad feature is the fact that most coal companies refuse to bid on B.t.u. contracts, and this includes the largest bituminous coal company in the United States. The few companies that do bid on B.t.u. contracts in practically all cases protect themselves by quoting a higher base price than they would ordinarily do, and so force the consumer to pay a tax for the privilege of buying on such a contract.

In buying on chemical analysis there is another source of error involved, which should be apparent to anyone who has had much to do with the practical application of coal. This is caused by the fact that conditions in a chemical laboratory and those under a steam boiler are not identical. For instance, the laboratory test for B.t.u. is made in a bomb containing pure oxygen and under conditions that are perfectly suited to the fuel that is to be burned. Such ideal conditions are foreign to a power plant. There the coal must suit the operating conditions rather than the conditions fit the coal.

Experience of a Michigan Plant

To illustrate, take the following experience of a Michigan steam plant. This plant is equipped with V-type stokers and vertical water-tube boilers operated at 200 per cent of rating, which necessitates forcing the fires with resultant high furnace temperatures. This plant decided to try the B.t.u. contract and solicited bids from a number of coal firms. The bids and analyses furnished by these firms were classified, and it developed that the final choice lay between a coal from the Harlan bed of eastern Kentucky and one mined from the Winifrede seam in Mingo County, West Virginia. The proximate analyses showed that the Harlan coal had 14,000 B.t.u. per lb. and less than 5 per cent ash, while the Winifrede coal, though just as low in ash, had only 13,800 B.t.u. As the mine price on both coals was the same, the business was placed with the Harlan company. The coal arrived at the plant, was dumped into the hoppers and fed to the fires. In three hours the plant was shut down tight. As soon

as the coal was fed onto the grate bars, it began to coke. This prevented the uniform admission of air through the fuel bed, cut down the combustion rate and caused islands of coke to be built up in the fires. Holes formed between these coke islands, admitting quantities of excess air, and the steam pressure began to drop. Because the fires were thick with unburned coke, they refused to slide down toward the clinker grinders in accordance with the stoker operation, so it was necessary to open the furnace doors and push the coal down with slice bars. As soon as these doors were opened, more excess air rushed into the furnace, thinning the coal gases and reducing the furnace temperature. And the steam pressure dropped still farther.

All Attempts Failed

The rate of coal feed was then cut down and the dampers opened wider in an attempt to thin the fires and, by drawing more air through the fuel bed, overcome the coking of the coal and so start the air flowing more uniformly under the entire grate surface. This not only failed, but caused still larger air holes to form between the coke islands. Now and then, when the coal got too thin on the lower parts of the grates, the weight of the fuel higher up would cause an avalanche that would entirely block the clinker grinder and prevent the discharge of the ash. As if this was not enough misery for one plant, it became apparent that the intense heat in the furnace, which was reflected back onto the fuel bed by the firebrick arch, was causing the coal ash to form into a sirupy clinker which was slowly but surely filling up the openings between the grates. The demands of the engine room for more steam, which had been getting more insistent as the pressure gradually dropped, had by this time become profanely hysterical. The firemen sweated with heavy slice bars, trying to keep the grates covered and the air openings clear of clinker. It was of no use. Machine after machine had to be taken off the line until finally they faced the inevitable—a complete shutdown.

Now the coal had been bought according to a standard B.t.u. contract. Nevertheless, it was absolutely unsuited to this plant, for there were coal qualities of more importance to that particular outfit than high heat value and low ash. One of these points was ash fusibility; another was coking tendencies. Even the best Harlan fuses at less than 2,700 deg. F., and this particular fuel happened to have a 2,450-deg. fusing point. The coking properties of good Harlan coal are so well established that it is one of the leading byproduct coals of this country. It should never be fired in a Dutch Oven such as a Murphy furnace, especially in a plant where the fires are forced so that a high furnace temperature is generated.

Fusing Point Should Be Specified

On the other hand, the Winifrede coal which the buyer rejected under his B.t.u. contract averages a fusing temperature of over 2,900 deg. and is free-burning. In spite of its lower heat content it was the coal that the plant should have bought. The B.t.u. contract did not reveal the unsuitability of Harlan coal for that plant because it did not take coking qualities and fusion temperature into account. It could not cope with coking for there is no laboratory test known that gives a reliable measure of this tendency. A clause could have been inserted specifying a minimum fusion point of ash, and a laboratory test would have given some indication of what might be expected in a boiler furnace, but actually such a clause almost never is carried in a B.t.u. contract, and this includes United States government contracts, which are more carefully prepared than those of the majority of steam plants.

A number of industries have worked out a practical coal-buying system that is a combination of analytical buying and actual test, and these report that they have saved both time and money by its use. They state their method as follows:

Studying the Conditions

The first thing a buyer must do in order to buy coal intelligently is to get thoroughly acquainted with his boiler-room conditions and limitations. To do this he does not need a course in chemistry or combustion engineering. For instance, if his boilers are equipped with natural-draft chain-grate stokers, he does not need to be an engineer to know that highly coking gas coals are not for him. Or, if he is using inclined overfeeds and operating at high ratings, he should know that a low-fusing-point coal will probably clinker all over his grates. Such facts are elementary, and to master them completely takes only a small part of the time that the average man spends in studying the far more intricate subject of his radio hook-up. Good books are of assistance along these lines, especially the various pamphlets issued by the Bureau of Mines, which are mailed free or else at a small cost. A complete list of these publications will be mailed free to anyone writing the Bureau, but it would be well to request at once Technical Paper No. 80—"Hand Firing Soft Coal Under Power-Plant Boilers"; Technical Paper No. 240—Boiler and Furnace Testing"; Bulletin No. 123—"Analyses of Mine and Car Samples of Coal"; and Bulletin No. 209—"Fusibility of Ash from Coals of the United States." The Keystone Coal Catalog is invaluable to a coal buyer as an aid to checking mines, seams and shipping points. With these books and a reasonable amount of observation of his own boiler-room conditions, any buyer will be able to judge the value of the different fuels offered by coal salesmen.

The next step is to get in touch with four or five reliable coal companies. The accent is on the word "reliable," and by this is meant companies whose methods of doing business, reputation for taking care of contracts and regular customers under all market conditions, willingness to guarantee their coal quality and the regularity of shipments and whose careful and uniform methods of preparation of their product are without question. There are many such companies and they are easy to locate.

Buying Coal for Test Purposes

Outline the operating conditions, such as the make and type of boilers and stokers or hand-firing. If the fuel is to be mixed with plant refuse, mention this fact, and tell what kind of refuse it is, for this point is of great importance when selecting proper coal. Give all other facts of interest, such as the ratio of grate to heating surface, chimney capacity, strength of draft, character of the plant load, and so on. With this information the coal company should be able to pick from its several operations the coal that experience has shown to give the best results in plants similar to yours. When their salesman calls, take him into your boiler room and show him around. He is not as close to your problem as you are and he may see something

you have missed. Listen to what he has to say, and when he recommends and quotes on a coal, ask him for the mine name, the shipping point, seam from which it is mined, the railroad it is located on, and the freight rate to your plant.

If you are satisfied that all is as represented, place an order for enough coal to give you a good test under your boilers, say enough for a four-day run. Follow this same procedure with the three or four other firms that quote, but take care that your shipping instructions are so placed that you will have ample time to isolate and test each trial lot as it comes in.

Preparing Samples for Test

When the coal arrives, see that it is dumped where it will not be mixed with other fuel, and take as accurate a sample as possible. For the best method of sampling see Bureau of Mines Bulletin No. 116. Place the finished sample in two one-quart airtight containers, mark them plainly with the car number and date of shipment, and send one container to a chemist for proximate analysis, including the ash fusion point. Keep the other for use in case of dispute or loss of the first sample.

Now proceed with your boiler test along the lines laid down in Technical Paper No. 240. Keep all records carefully and accurately so that the final coal cost per thousand pounds of steam will mean something. When this has been done with all five coals, the next step is to pick out the two or three that gave the most satisfactory operating conditions and made the cheapest steam, and place a larger order with these firms for a longer test. Be sure to specify that the coal shall come from the same mines as the first lots, and check the freight bills to see that it does. When this coal has been tested and has shown satisfactory results, you are ready to place your contract.

Furnish the coal firm whose product has proved to be the most economical with copies of the analyses you have taken on their test shipments and ask them if they consider these to be average of their coal from that particular mine. If they say that they are, then tell them that you are going to insert a clause in the contract giving you the option of cancelling if at any time during the life of the contract the coal applied on it falls below this average quality. If they object to your analyses, ask them for one that they consider to be representative. Nine times out of ten you will find this to be just as effective for your purpose as your own analyses. In writing up the contract, be sure to insert the mine name and shipping point. It is always a good plan to contract for slightly less than your annual requirements, thus leaving room for a few tests each year in order to keep abreast of changing conditions, new mines, etc.

Boiler-Room Records Should Be Kept

Having contracted, you can forget analyses for the time being, but keep up the boiler-room records. Then if the evaporation starts to fall off and the steam costs climb, you can get after the trouble at once. If a physical examination of the boiler-room equipment or a check of firing methods does not reveal the trouble, have the coal analyzed and compare the result with the original analyses. If this shows the coal quality to be inferior, you won't have much trouble convincing a reliable coal company of the fact. They probably will have heard about this falling off in quality from several customers, and in these days of stiff competition among the bituminous coal companies it is policy for them to make a reasonable allowance and retain their customers. Owing to the uncertainties of coal mining, a falling off in quality is inevitable even in the best-managed mines, but no standard company ever allows these conditions to obtain for a longer period than it takes to locate and correct them.

In case, after making your tests, you prefer to buy on the open market, you are in touch with several sources, any one of which will furnish a satisfactory coal.

The use of pulverized-coal systems has done much to revive the purchase of heat units rather than a particular coal. These systems approach the theoretical more closely than any other known method of the combustion of coal. But even they have their operating troubles, which differ with certain fuels, and the unit systems especially must be supplied with a proper size and character of coal if they are to function at their highest efficiency.

In the last analysis the requirements of an economical coal-purchasing system are not complex. A little understanding of what is required, and a little common sense in its selection; integrity in the contracting parties and hence their co-operation to the end that the best interests of both be served. The result is sure to be a steady supply of uniformly satisfactory coal and minimum steam costs.

A Unique Automatic Hydro-Electric Installation

One of the most interesting automatic hydro-electric plants so far put into service is the Parishville Development of the St. Lawrence Valley Power Corp., Potsdam, N. Y., which went into service recently. In this installation a 3,080-hp. plate-steel spiral-cased Allis-Chalmers turbine operates under a 130-ft. effective head. The water is brought to the turbine through a penstock 2,800 ft. long and 6 ft. in diameter. There is no surge chamber connected with the pipe line, and no pressure regulator, relief valve or bursting plates connected to the turbine, and no governor to control the speed of the unit.

The station is entirely automatic in operation and in case of trouble that would cause the generator to be disconnected from the line, the unit reaches its full runaway speed before the protective devices cause the turbine gates to close. With the gates wide open, within 4½ sec. after the unit has been disconnected from the line, the speed increases to 104 per cent above normal, but the pressure rise in the penstock is less than 30 feet.

This is probably the only station of any appreciable capacity that is operated in this manner. The severe winter conditions made the problem of heating a surge tank difficult, and the complications of a pressure regulator and speed governor would have added greatly to the initial cost of the installation without in any way improving the conditions for load on, which might cause a serious drop in pressure, even resulting in collapse of the penstock. Such an installation as this is possible only when used in connection with a relatively large system, where the fluctuations in load can be absorbed by other units in other stations equipped with governors.

POWER WEEK IN CHICAGO

TO CONSIDER power problems of the Middle West and to afford engineers of that section an opportunity to inspect new and improved power equipment, the Midwest Power Conference and Power Exposition have been scheduled for the week of Jan. 26 to 30 in Chicago. The conference is sponsored by the local sections of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, the American Institute of Mining Engineers, National Electric Light Association, Western Society of Engineers and the National Safety Council. Through a comprehensive four-day program, to be opened by Samuel Insull, president of the Commonwealth Edison Co., a number of prominent engineers will discuss trends toward economy in production from the viewpoints of steam, hydro and oil power. Plans for securing better economy in industrial power plants will also be discussed, as well as interconnection in the North Central States. The technical program will be supplemented by a number of inspection trips to several large power stations and industrial plants in the vicinity. This will include the Crawford Avenue Station of the Commonwealth Edison Co., where the visitors will have an opportunity to see in operation under one roof the three 60,000-kw. turbo-generators, each of different design and one of which was brought over from England. This station is operating at 550 lb. and employs reheating between the high and low-pressure turbine elements.

Mid-West Power Conference Program
Chicago, January 26-29

Tuesday morning—Registration.

Tuesday afternoon—W. L. Abbott, chairman. Address by Samuel Insull. "Some Comments on the Power Developments of the Mississippi Valley."

Wednesday morning—B. F. Lyons, chairman. "What We Can Expect from Hydraulic Power in the Middle West," by Daniel W. Mead; "Changing Viewpoints in Hydraulic Turbine Practice," by H. Birchard Taylor; "Superpower in the North Central States," by R. F. Schuchardt; "Rural Electric Service," by G. C. Neff.

Wednesday afternoon—Homer E. Niesz, chairman. "Recent Developments in Electric Power in the Chicago District," by William S. Monroe; "Present Practice in the Burning of Pulverized Fuel," by C. F. Hirshfeld; "Byproduct Processing of Coal," by H. W. Brooks; "Boiler Water Conditioning, with Special Reference to High Operating Pressure," by Dr. R. E. Hall.

Thursday morning—James E. Herron, chairman. "Layout and Equipment of Industrial Power Plants," by Paul L. Battey; "A Machine for Testing Steam-Turbine Nozzles by the Reaction Method," by G. B. Warren and J. H. Keenan; "Safety and First Aid in Industrial Plants," by C. B. Scott; demonstration of first aid by a team from a Chicago organization; "Planning and Operating Industrial Hydraulic Plants for Best Economy," by L. F. Harza; "Purchased Power for Coal Maines in Illinois," by J. Paul Clayton.

Thursday afternoon — Inspection trips to the Crawford Avenue Plant of the Commonwealth Edison Co., the printing plant of the *Chicago Tribune* and the Underwriters' Laboratory.

Thursday evening—Dinner Meeting, Charles Piez, toastmaster. The subject will be "The Effect of Wide Power Distribution and Availability on the Social and Economical Life of the Country." The speakers will be J. A. Emery, vice-president of Ford, Bacon & Davis, and Gen. Charles Keller.

Friday morning—A. A. Potter, chairman. "The Diesel Engine in the Industries," by Max Rotter; "Diesel-Electric Locomotive, Its Present Status and Performance and Its Future Possibilities," by Samuel M. Vauclain, president of the Baldwin Locomotive Works; "The Economics of Oil as a Boiler Fuel," by Allen F. Brewer; "Present Status of Byproduct Gas Furnace Practice," by H. H. Clark.

Friday afternoon—Group inspection trips will be arranged as desired to plants of interest. Plants that visitors may like to see are the Western Electric plant at Hawthorne, the new plant of the International Harvestor Co., Chicago Avenue Pumping Station and the Chicago Stock Yards.

The Power Exposition, which will be held simultaneously with and in the same building as the Conference, will include approximately one hundred and seventy-five exhibitors. This is more than the first year of the New York Show, which, if to be taken as a criterion, gives the new show promise of becoming a worthy contemporary. While many of the exhibits will be the same as those seen in New York in December, there will be about sixty new exhibitors, which will make it worth while for those who visited the earlier exposition. Some manufacturers will demonstrate their products by units in actual operation; others, whose assembled products are too large to permit of housing in the showroom, will display models; and still others will demonstrate oper-

ation through the medium of movies. The show will bring out what is new in the way of powdered-coal equipment of all types, air pre-heaters, water-cooled furnace walls, stokers, draft apparatus and other devices to increase the effectiveness and economy of combustion. There will be a particularly attractive exhibit of electrical equipment with switchboard display, instruments, oil switches, etc. Valves of all types for the higher pressures and temperatures, regulators and many other power-plant specialties will be on exhibit. New features in boiler design and in auxiliaries for all departments of the power plant will be shown, and there will be a complete display of heating and ventilating specialties—in fact, the show in its entirety will give an excellent idea of the present status of the art and the progress that has been made in all lines of equipment used in the power plant.

Furniture Mart Building where the Midwest Power Conference and the Exhibition will be held

The exhibits will be shown in the American Exposition Palace of the Furniture Mart Building located on Lake Shore Drive and within a short distance of the Loop and the leading hotels. The doors will be open daily Jan. 26 to 30 inclusive, from noon to 10:30 p.m., and all persons attending the Power Conference will be admitted to the Exposition by cards provided at the registration desk of the conference, where a nominal registration fee of one dollar will be charged to cover the facilities of the meetings and other incidental expenses.

A ladies' committee is arranging a comprehensive program for the ladies during their visit to Chicago. This will include visits to various points of interest, as well as shopping tours, teas, etc.

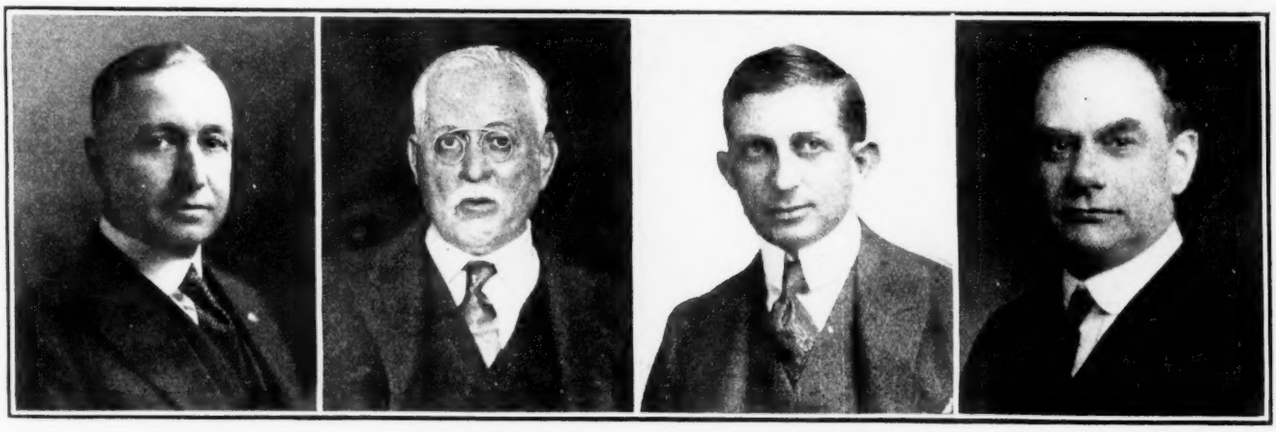
The slogan of the Exposition for which a prize of $100 was awarded to W. W. Hatton is "Power Controls Man's Progress." In explanation of the slogan Mr. Hatton says:

"Since man fashioned the first crude tools from trees and rocks, his progress has been ever cumulative. His use of tools, and their refinement, power, has marked the several steps of progress in civilization. His utilization of the water-driven wheel, the stored energy of combustion, the power of controlled steam and gas, all led to the innumerable uses of electricity when that marvel was brought within his ken.

"Today, vast as has been his accomplishment in the physical realm, let him in humility study the giant steps of his progress and admit the possibility of even more amazing advance in applying the forces of Nature; let him use his accumulated knowledge for devising further aids to civilization, to the end that mankind, having lifted to some extent the curse of Adam, may have more leisure, acquire more culture and greater opportunities to develop the soul."

Chicago, the center of a five hundred mile area embracing the largest number of power-generating stations of any section of similar size, offers an ideal location for such an exposition. Moreover, it is central to many of the equipment manufacturers who are exhibiting and within easy traveling distance for a large body of engineers. For this reason a large attendance is expected.

According to present plans both the power conference and the exhibition will become an annual event.



Homer E. Niesz, president of the Western Society of Engineers

Samuel Insull, president of the Commonwealth Edison Co., who will deliver the opening address

B. F. Lyons, president of the Great Lakes Section, N.E.L.A.

W. L. Abbott, president of the A.S.M.E. and chairman of the general session

Some of those who will take an active part in the Power Conference

The Welding and Cutting Torch in the Power Plant

By L. A. COWLES

SINCE the invention of the hammer and the saw no tool has been produced with a wider field of application than the oxy-acetylene cutting and welding torch. Its uses in the power plant alone are legion. In this practical and suggestive article the author tells of thirty power-plant jobs — no two exactly alike — on which the torch has saved him time, money and trouble.

SINCE the publication in the July 21, 1925, issue of *Power*, of my letter on "The Welding and Cutting Torch in the Power Plant," requests have been received asking for more details on the various kinds of work we were able to do with the torch. As there stated, I have been using a torch for three years and am finding new uses for it every day. It is the most useful tool in the power house or shop, as one can build up or tear down with it. The first cost is low and the cost of gas and materials small when compared with the savings effected in time and materials and in the prevention of shutdowns.

To be more specific, I will list from my time cards for the last year, a few of the uses I have made of the welding and cutting torch. One of the first items encountered is the reinforcing at the heel of coal and ash scoops, practically doubling the life of these tools. Often a scoop will break or a crack develop, which can be repaired with the torch, thus saving the scoop from the scrap heap.

Fire tools, especially for hand-fired furnaces, are a constant source of trouble; the usual procedure is to buy or make a new tool when only the hook or point is worn out. In such a case welding will often not only save the old tool, but make it stronger than when new by reinforcing the weak spots.

In another case a hole developed in a boiler tube. To remove the tube would have called for at least two days' work in taking out the baffles, cutting the tube, putting in the new tube and replacing the baffles. The hole was welded in less than thirty minutes and the tube has given no trouble since, notwithstanding the fact that it has been subjected to 150 lb. steam pressure for three years.

In piping a centrifugal pump, it was necessary to bring in 4- and 3-in pipe lines at an angle of about 10 deg. with an offset to clear the concrete fillings. With fittings this would have been a difficult job. Moreover, the cost of the fittings alone was estimated at $240. With the cutting torch the job was simpler and much cheaper, as it was possible to cut the pipe to fit in position and then weld the joints. The actual cost of the work was $15 for gas and materials, and the saving in time was the largest item of all.

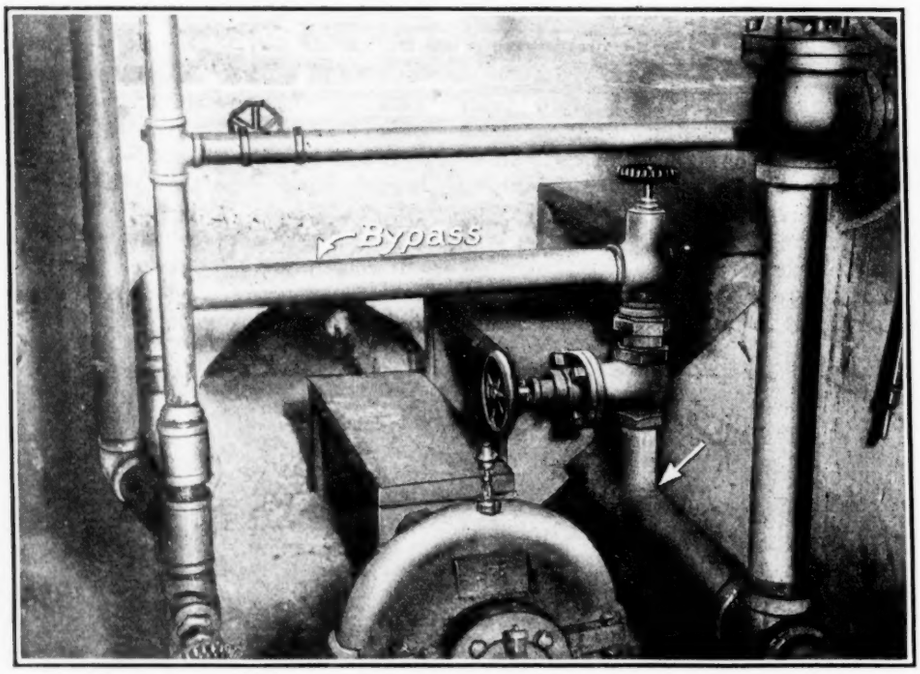


Fig. 1 — In cramped quarters, where it would have been impossible to cut or thread pipe, a much needed bypass around a centrifugal pump was set in with the aid of the torch. The arrow shows one of the welds

Bad feed-water conditions resulted in the feed line pitting through in less than two years, but except for a few pinholes the pipe was in good condition. The

cost of replacing the pipe—labor and shutdown considered—would have been comparatively high. By welding the pinholes as they were discovered, much time and material was saved without shutting down the boilers, as the particular section of the feed line involved was closed down and drained and the welding completed in a few minutes.

The casting connecting the plunger to the rod of an outside packed pump failed. This casting was not kept in stock, and we would have been left for two weeks with only one feed pump if it had not been for the welding torch. In two hours the piece was welded, the pump was back in service and a new casting ordered, which, up to date, has not been used. Another job was a broken valve screw which was brazed and is still in service.

Welding a Branch Pipe Line

It was desired to take a 1½-in. branch line from a 6-in. steam main, with not a union in sight. Moreover, 6-in. flanged tees run into money, and it takes time to cut a 6-in. pipe and thread it. This was another easy job for the torch. The piping for this line was put in and the connecting pipe placed on top of the 6-in. main, ready to cut and weld. The steam was shut off, a hole was cut with the torch and the 1½-in. pipe welded on in just twenty minutes at a cost of three dollars. This may be compared with the services of two men for two days, the cost of one 6x6x1½-in. tee, gaskets and time out for the line. Since cutting in this pipe we have used the torch for several similar jobs.

A leak around the pipe threads in a 6-in. elbow, with no unions between fittings, provided another interesting job. The leak had to be stopped, which ordinarily would mean cutting the 6-in. pipe by hand, putting in unions and pulling up the pipe to stop the leak. Instead, we cut the pipe in two with the torch, gave the pipe end a

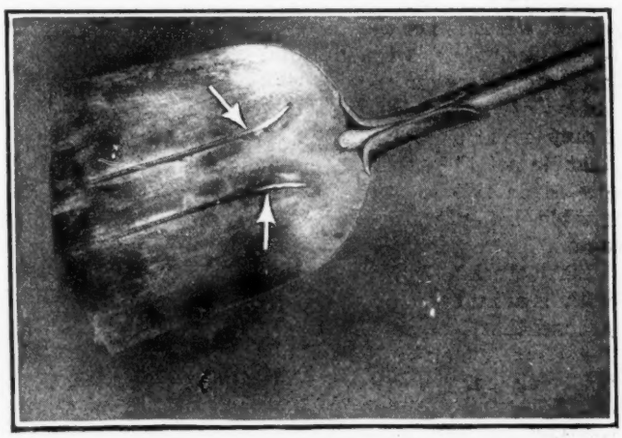


Fig. 2—Quarter-inch iron reinforcing welded on the ash scoops as shown, more than trebled their life

turn and a half into the elbow and welded the two sections of pipe together again. Only one length of pipe covering had to be removed. The time required for the job was two hours.

A 2-in. pipe plug was needed, but none was available. We had a short piece of 2-in. pipe threaded on one end and, by heating and pounding together the threadless end of the pipe and welding this edge, produced a satisfactory plug.

Another job was the removal of an old pipe line in which the bolts and fittings had rusted to such an extent that it was almost impossible to take them apart without smashing the fittings. One man with a cutting torch, doing the work of three, did the job and incidentally saved all the fittings.

A boiler breeching had rusted out on top and down each side at the junction with the stack. With the cutting torch enough sheets were cut from an old gas

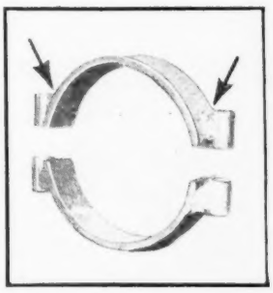


Fig. 3—Clamps for wooden pipe were made by cutting steel pipe with the torch and welding on ¾-in. nipples for the bolts

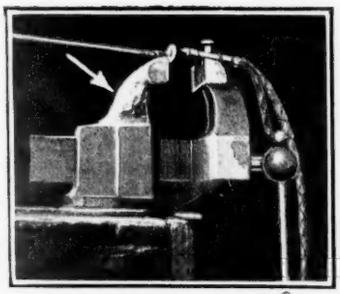


Fig. 4—A vise with broken jaw was made as good as new by welding the jaw in place. It is the usual practise of the author to leave a weld rough where feasible

tank to join the breeching properly with the stack. The result was a smooth repair job finished much sooner than if it had been riveted.

Time and money were saved by using the torch to cut thirty holes, ranging in diameter from 1 to 3 in., in some heavy steel boxings. Contact terminals on a motor-starting switch that had burned down too short were built up with the torch.

The impeller on a centrifugal pump had worn loose on the shaft. In this job the shaft was built up with the torch and then turned down to a driving fit at a cost of four dollars. A new shaft would have cost eight dollars, not to mention the express charges and the two weeks' wait for it. It will be noticed that the saving is not only the salvage of the broken part, but also the cost of ordering delays, shipping mistakes, obsolete parts not obtainable and time out for apparatus waiting for repairs. I have even used the torch for repairing the holes in pots and pans, welding broken grate bars and brazing together high-tension busbars.

Welding an Outboard Bearing Support

An outboard bearing support was broken in shipment and repair was made by welding. This saved much time, and payment for the job was made by the shipper. Bands were needed to repair some old wooden water mains, so a 6-in. pipe was cut into 1-ft. lengths and each length cut into halves longitudinally. Three-quarter-inch couplings were welded two on each side and four to a clamp for bolting these semicircular supports around the wooden water mains. Previously, a blacksmith had charged $60 for ten clamps, but by the method described, ten clamps were made for $18 and they were so much better as to fit and strength that no difficulty was experienced in stopping the leaks. As much cannot be said for the work that is done by the blacksmith.

A broken gear tooth was built up and is giving good service. A water-weighted roller used on the tennis

courts sprang a leak and was repaired. When drilling a hole through concrete, heavy reinforcing bars were encountered and cut out with the torch. A special engine wrench was broken and repaired by welding. A set of socket wrenches had been discarded as many of the sockets were split. All of them were repaired and reinforced so that they were stronger than when new.

Removing Boiler Tubes with the Cutting Torch

When retubing our boilers, we use the cutting torch to remove the tubes, because the work is done more quickly and there is no necessity for tearing down the brickwork at both ends of the boiler as is required when using a tube cutter.

Another use of the torch that has saved us much time and money is in connection with pump liners that have become loose in the cylinders. The practice is to cut them lengthwise on one side, spread the liners slightly and then fill in with bronze by the use of the torch. The liners are then smoothed up on the lathe and driven back into place. Heating the center of large bolts that are to be pulled down and shrunk tight is another job for which the torch can be used to advantage.

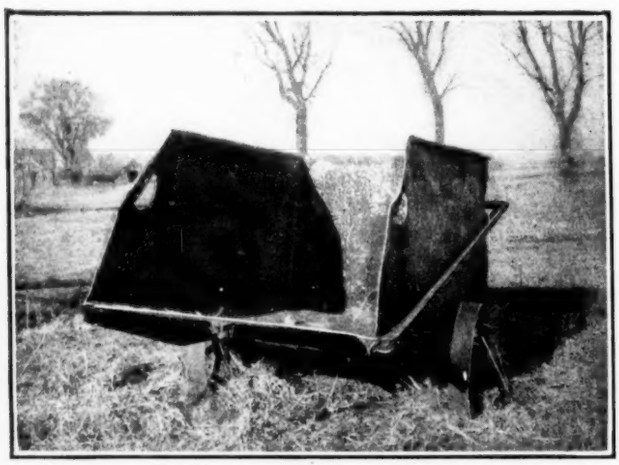


Fig. 5—Coal car made from an old gas tank, standard pipe and two junked wheels

After being turned down on a $125 requisition for a new coal car, the author made his own at a cost of $8 for gas. He cut up the old gas tank with the cutting torch, welding sides and end piece on the piece cut for the bottom. A 2-in. pipe was welded on for an axle, while a 1¼-in. pipe served as a handle. The car holds 1,500 lb. of coal.

Many engineers think of the welding torch in connection with large, heavy jobs. But even metal as light as that used in common tin cans can be brazed. I never use a gasoline torch for soldering, as the time and gas used will more than pay for the extra cost of acetylene. With a small tip applied directly to the work a better job of soldering can be done.

I make the welding repair jobs spare-time work. There are always half-hour and often hour periods during the day when one has finished some piece of work and does not wish to start a job that cannot be completed. This time can be used for welding repairs to good advantage, and it is surprising how many repairs can be made with the torch in these spare moments ordinarily spent in discussing the price of bacon.

If there is any place where continuity of operation is important, it is in the power plant, and of all the tools used to achieve this result through quick, permanent repairs, the torch heads the list. Another thing in its favor is that practically any engineer or repairman can learn to operate the torch in a comparatively short time.

The Cracking of Boiler Plates

The following paragraphs, discussing the long-standing controversy regarding the cracking of boiler plates, are quoted from an editorial in the November 20, 1925, issue of *The Engineer* (London).

The views that are at present held may be grouped roughly into two classes—those that ascribe cracking to a form of corrosive (chemical or electrochemical) action and those that seek the cause in severe local stress in the vicinity of the rivet holes, whether caused by undue concentration of working stresses or by the play of internal forces arising from the construction of the boiler. In America the view that boiler plate cracking is due to the action of caustic soda in the boiler water prevails. It is suggested, but has never been conclusively proved, that at high temperatures and pressures, soda attacks steel and produces intercrystalline cracking—a feature highly characteristic of these boiler failures. It is said, furthermore, but convincing evidence has yet to be produced, that the presence of dissolved sulphates in the water entirely inhibits the deleterious action of soda.

Experiments have, again, been made to show that a mild steel under stress can become embrittled by the absorption of hydrogen formed by electrolytic action in which the steel acts as anode. Such embrittlement cannot be denied, but—does it occur in boilers, even when caustic soda is present in the water? Moreover, steel thus embrittled breaks with a short fracture it is true; but not with an intercrystalline one. If therefore hydrogen embrittlement enters into the boiler phenomena at all, it is not the only important factor.

Another view is that the intercrystalline cracking of mild steel in boiler seams is due mainly to the prolonged action of severe stresses set up in the steel by unduly heavy riveting pressures, by forcing together plates that do not fit properly, and similar causes. It is suggested on this view that the corrosive action of undesirable boiler water acts simply as an accelerating agent, just as corrosion is known to do in the so-called 'season cracking" of brass and other alloys. The analogy with season cracking is, indeed, very strong on the ground that intercrystalline fracture, which is so very rare in metals and alloys, occurs in both cases.

The diversity of views does not end at this point. The quality of the steel is also brought into the case as, it is pointed out that a steel that has been subjected to low-temperature annealing, so that it contains "balled up" cementite rather than well-distributed pearlite, is exceptionally liable to this type of failure. Then, again, it has been suggested that the cracks are, in reality, due to fatigue arising from the repeated "breathing" of the boiler as its temperature changes. This view, however, is difficult to accept, if only on the ground that the cracks are not in the least of the type that we know to result from fatigue; while, furthermore, the number of alternations that could occur from such causes is far too small to account for fatigue failure, except under excessively severe stresses. Whichever of these views, if any, may be the true one, is a matter of opinion.

The Cutting and Welding Torch

SOME of the favorite lecture experiments of the old-time chemistry "prof" centered around a glass jar full of oxygen. An expiring match burst again into flames when thrust into the jar. A steel watch spring, preheated at one end enough for ignition, burned in the oxygen with a shower of sparks. But in the eyes of the students the most wonderful experiment of all was the burning of a diamond—a small cheap one, but still a diamond. Ignited in the jar of oxygen by an electrically heated platinum coil, the jewel was completely consumed in a few moments, leaving a trail of carbon dioxide to prove that it was after all nothing but a piece of crystallized carbon.

These demonstrations were designed mainly to excite wonder and interest, but their significance did not stop there. The combustion of iron and steel in a stream of oxygen from the oxy-acetylene torch has become one of the fundamental processes of industry. This is only natural in view of the fact that the torch cuts sheets, plates, structural-steel sections, piping, etc., almost as easily as the grocer's knife cuts cheese. The metal removed actually burns itself away in an atmosphere of oxygen, the acetylene serving merely to preheat it to the ignition point. The fact that the oxyacetylene outfit with a slight adjustment serves equally well for cutting down and building up has had much to do with its widespread application in industry.

In the power plant the welding and cutting torch has numberless uses. The outstanding power-plant application is in the fabrication, repair and extension of piping systems. But its usefulness does not stop there. The torch is used daily to cut out boiler tubes, repair stokers, conveyors and coal cars, recondition firing tools, repair leaks in tanks, salvage broken pumps and engines, etc. Thirty such power plant uses are listed in the article on page 146.

In view of the tremendous versatility of this modern tool a considerable knowledge of its technique and application is an essential part of an engineer's education.

Unnecessary Delay

AS A closing act for the year 1925 the United States Senate unanimously passed a resolution suspending until February 1, 1928, the jurisdiction, power and authority of the Federal Water-Power Commission to issue licenses for the purpose of constructing, operating and maintaining dams or reservoirs on the Colorado River and its tributaries. Not an inquiry as to the effect of the action was made by any member when this far-reaching legislation came before the Senate. Fortunately, this act of the Senate has to be passed upon by the House, and will receive more deliberate consideration.

Not satisfied with this, effort is now being made to place a similar restriction on the Tennessee and Columbia Rivers. The Colorado and Columbia have not been completely surveyed, and there may be reasons for delaying licenses for developments on these rivers, but the Federal Water Power Commission has made it a practice not to grant licenses for water-power developments on any stream until it has been ascertained how they would fit into the complete development of the river, as was its policy on the Tennessee River. Now that this river has been surveyed and a tentative plan of development has been laid out by the Army Engineers, there seems to be no logical reason for delaying for two years the issuing of licenses for power developments. What assurance is there that at the end of two years Congress will know any more about what it wants to do than it does at the present time?

For nearly eight years Congress has been discussing Muscle Shoals and has not found out what is to be done with it yet, and the possibilities are that a number of years more will pass before the final disposition of this project is made. But why hold up power development on the whole Tennessee River for this one project, when any development that may be made farther up the river cannot fail to be beneficial to the Government project at Muscle Shoals? The State of Tennessee has waited for the federal government to survey this river system and now has just reasons for her demands for the river's earliest possible development. If Muscle Shoals must be a political football, let it be so, but this is no reason that over one million horsepower of water power must be delayed in its development.

A Workmanlike Job Inspires Confidence

THE first cost of good equipment properly installed is only one of the economic factors entering into motor and controller installations. One shutdown due to a motor failure may easily cause a loss equal to more than the difference in cost between the best equipment well installed and low-grade apparatus in a cheap installation.

This, however, does not mean that the highest-priced equipment used in an expensive installation is always the most economical. The service to which the apparatus is subjected and also what effect the failure of a motor or controller will have upon production, must be considered. If a motor can be shut down for a considerable period without interfering with the rest of the plant, the expense necessary to prevent such a shutdown might not be justified, as it would be in the case where the stopping of a motor would interfere with the operations of a number of other machines. But in any case good equipment well installed has much to recommend it.

The article in this issue, "Tendencies in Electric-

Motor Control Installation," by J. Elmer Housley, hits at the very root of the problem when he says: "The greater the convenience and ease of operation of equipment, the better care it will be given by the operators. A substantial and workmanlike job inspires confidence, whereas a makeshift installation will be handled as such." Too often, motors and controllers are installed in a location that nothing else will go into, without any consideration as to how they are going to be maintained and kept in service.

The installation of the equipment may be a matter of only a few hours or days at the most, but its operation is measured in years. Inspection and care of motors and controllers have in many cases to be made while they are in service. If those responsible for the installation of the apparatus are short-sighted enough to create a human hazard in its location, the attendants cannot be expected to put themselves in jeopardy every time they attempt to care for the equipment. One of the first requisites to caring for equipment is to install it so that the attendants will have confidence in and take pride in keeping it in first-class condition. Money spent to do this is generally well invested.

Cheaper Steam Turbo-Generators

SUCH reductions as have been made in the cost of producing power in the last few years have been due partly to improved performance of the newer stations and partly to lower coal costs. There has been a general trend to higher fixed charges for some time. Any factor that would tend to reduce station investment and therefore fixed charges must command the attention of all power engineers.

Such a factor appears to exist in the design of new steam turbines and generators. The limiting capacity of a straight condensing turbine is the amount of steam that can pass through the last row of blades with a given vacuum and a given leaving loss. The probable yearly average vacuum at the purchaser's plant should be carefully determined and the leaving losses evaluated against this vacuum. Too many machines have been purchased for twenty-nine inches vacuum when the yearly average is somewhat less than this. A greater capacity can be obtained from a given frame with the same leaving loss per pound at the lower vacuum and at no greater first cost of construction.

Most turbines are now bled at various stages to heat the feed water. If the same turbine cylinder and the same total steam flow to the condenser are employed as for non-bleeding, this feed heating can be done only by additional steam admitted at the throttle. It is not a difficult or expensive matter to proportion the nozzles and blading in the earlier stages to care for this additional steam flow. In fact, this increased flow in the first stages tends to increase over-all efficiency for a given size of casing.

Such increased steam flow to the various bleeding points will generate power in addition to that generated by the steam passing to the condenser and therefore will increase the total capacity of a given cylinder over non-bleeding conditions. The more points at which steam is bled the greater will be this increase in capacity. This is a potent argument in favor of many-stage bleeding. The combination of stage-bleeding with leaving losses adjusted to actual vacuum may result in an increase of 10 to 20 per cent in the cylinder capacity at a relatively small increase in cost.

A paper was reviewed in a recent issue in which the use of hydrogen as a cooling medium for turbo-generators was discussed. It was pointed out that a generator filled with hydrogen would carry one hundred thirty-three per cent load at the same temperature rise as when filled with air at one hundred per cent load. The increased capacity of the turbine can be taken by the same or even by a slightly smaller generator filled with hydrogen.

These considerations indicate that increased capacities of the whole turbo-generator units may be secured at small increase of production cost over present designs. If this saving is passed along to the purchaser, it will help toward a reduction in plant first cost and fixed charges.

The Thermal Properties of Steam

IT IS easy to assume that the steam table is correct to the last printed figure, but it isn't true. The total heat of steam, for example, commonly given to one-tenth of a B.t.u., is not known within several whole B.t.u. in certain ranges. The tables, however, give the tenths because small differences *are* known that accurately.

Thermal phenomena are so very difficult of precise measurement that any table of properties, whether of steam or other substances, resting as it does on purely experimental determinations, is liable to errors from a number of sources. Such errors are progressively reduced through successive experimental undertakings.

Power has already reported briefly concerning the steam table research work of the A. S. M. E., which was discussed fully during the last annual meeting, of the Society. This investigation is being checked against half a dozen others made within recent years, and its reliability is judged from the nature and extent of the discrepancies. Unfortunately, the considerations involved are of a highly technical nature, so that it is most necessary for the user of such material to take it on faith.

Confidence in the author is the only assurance most engineers have that the steam tables are dependable. Of course, this confidence is increased through experience in the use of the information for the design and checking of steam machinery, but before such experience has developed there must be a large exercise of faith. In the case of this latest investigation it is good to know that the A. S. M. E. Committee directing this work, and the investigators who are actually conducting it, are men of the highest technical attainment and unquestioned integrity. Every engineer is justified in reposing if necessary confidence in their published results.

The report of this work, preprinted in the form of a pamphlet including a table of volumes and a Mollier chart extending to high pressures and temperatures appears in full (including the table and chart) in the February issue of *Mechanical Engineering* together with a detailed report of the discussion presented at the meeting.

Those whose work requires reliable information on the thermal properties of steam should lose no time in securing all of this material. The information, it is true, is not final and it will be superseded in perhaps two years by still more complete and dependable results, but it is believed that the information as it stands today represents the best approximation yet published.

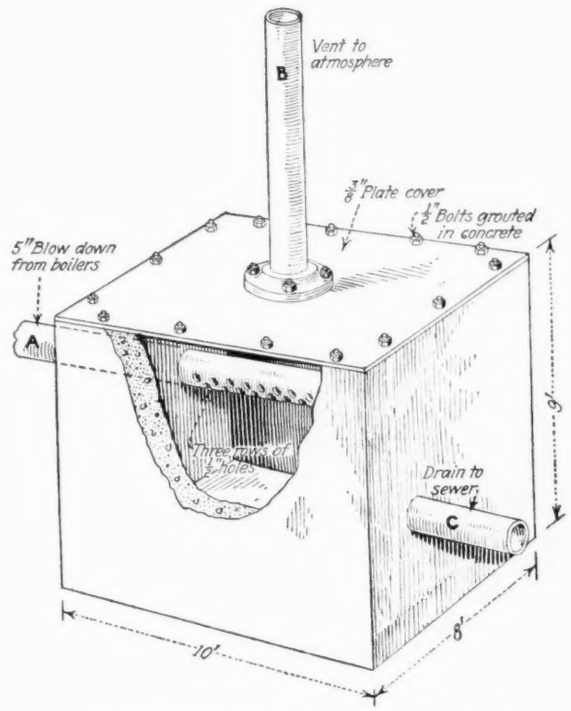
Practical Ideas From Practical Men

Blowoff Tank for Battery of Boilers

Many different types of blowoff tanks are in general use, and a number of these have been described, but it occurred to me that the one illustrated herewith may be of interest.

The illustration shows the design of a tank that has been in use for a number of years, handling the blowoff from a battery of boilers operating at 150 lb. pressure.

The 5-in. pipe *A* is connected with the blowoff valves. One-third of the circumference of the section of the pipe which extends inside of the tank, is drilled with a



Arrangement of concrete blowoff tank and connections

number of rows of ½-in. diameter holes, the center to center distance being 1½ in. When the blowdown takes place, the water enters the tank through the small holes, which break it up into a fine spray, thereby reducing the noise to a minimum. The vapor escapes through the vent pipe *B* to the atmosphere. Pipe *C* is the drain to the sewer, and it is about one foot lower than pipe *A*, so no water hammer can take place.

This type of tank can be set so that the top will be level with the surface of the ground, or it can be set above the ground, whichever is more convenient. The mixture for the concrete is one of cement, three of sand and five of gravel. The walls are made 12 in. thick, and the top, which is made from ⅜-in. steel plate, is held in place by a number of ½-in. bolts grouted in the concrete walls of the tank.

Pipe *C* is set about two feet above the bottom of the tank so that sufficient water will be retained to cool the spray of hot water and also to trap the sediment which is removed from the tank at intervals.

Norway, Mich. THOMAS PASCOE.

Experience with an Open Heater

The boiler-feed water in our plant is drawn from a near-by river. The amount of foreign matter in solution and in suspension in this water varies greatly. Use is made of an open heater which is mounted on a platform 10 ft. above the feed-pump floor. The 6-in. pipe from the heater to the pumps passes downward through this floor and is carried on the ceiling below. Two small pumps for circulating hot water through the factory buildings also are connected to this pipe.

The heater is cleaned regularly. A number of days after cleaning it was found that the pumps were short of water. As considerable hot water is used throughout the factory buildings, it would have been awkward to do without it, even for a short time. The pipe from the heater to the pumps was clear. It was discovered that the trouble was due to a coating of foreign matter from the water over the coke bed in the heater and that this coating prevented the water from passing through the heater as fast as required. To remedy this trouble without interfering with the service of the pumps, the discharge pipe from a pump with another source of water supply was connected into the suction pipe of one of the hot-water circulating pumps. This gave a reverse flow of water through the pipe and heater. The coating over the coke in the heater was lifted, broken up and partly carried away through the heater overflow, thus permitting the necessary amount of water to pass through the heater to the pumps.

Reversing the flow of water through the heater once a day, for a few minutes at a time, was sufficient to keep the pumps supplied with water until the end of the week, when the heater was thoroughly cleaned.

Elgin, Ill. W. L. PARKER.

Coal Ash or Cinders?

For a number of years I have been thinking that there should be something done to change the almost universal practice of calling coal ash cinders. This is followed by the members of the engineering fraternities also—if not at conventions, at least on the job.

It may be that engineers and others interested in the business, having to explain what ash is every time it is mentioned, get disgusted and they, too, call it cinders.

Recently, having had a call for a carload of ash to be delivered to a near-by town, the local freight agent was called on for the freight rate on coal ash. "Cinders, you mean," he said. "No, ash," was my reply. He said he would have to get this from headquarters. In a day or two he informed me that freight on coal ash

would be $1.20 per ton and on cinders $0.72 per ton. Being rather curious as to the difference between coal ash and cinders, I wrote them for their definition of these products and received the following reply:

Your letter of Oct. 20 to our agent at Bloomington relative to the difference in rates on cinders and coal ashes, in carload lots.

Your original inquiry to the agent no doubt brought on his request of this office for rates on coal ashes, to which we replied advising that if the commodity could be described as cinders the rate of $0.72 would apply and the rate on coal ashes would be $1.20. This is due to the fact that under the state law certain maximum rates are prescribed on certain commodities, one of which is cinders—coal ashes are not specified. The $0.72 is the prescribed maximum rate referred to, whereas we have nothing better than the straight classification basis covering the description on coal ash.

I am sure that you know that we can appreciate that coal ashes should be entitled to same basis as cinders.

It may be possible for us to secure authority to apply the cinders rating on any shipments of ash you may have, in which event I will advise you.

This may be as close an explanation as is usually given or generally known; however, it puts them on an even keel. As I get it, the definition of ash is the residue left after complete combustion and cinders are unconsumed coal.

As most power plants turn out ash with a low combustible content, why not get full credit for our labors and call it ash, not cinders? D. G. WALLACE.

Bloomington, Ill.

Some Practical Hints on the Brazing of Metals

The art of brazing is generally employed in power plants where greater strength is required on metal parts than can be obtained by soft soldering or where the work has to withstand a degree of heat that would cause soft solder to melt.

The essentials of a good brazed joint are the contact of absolutely clean surfaces free from oxide and dirt. The surfaces should be cleaned by filing, chipping, grinding or scraping, and if the job is greasy it should be dipped in a strong solution of boiling soda water.

Unfortunately, the actual brazing of flanges on copper pipes is often rendered insecure by bad methods. It is a common practice in some power plants to put the flange over the fire and blow up again until fluxing takes place; and thus previous to the charging with solder the collar top and the space between pipe and flange have become covered with dust from the fire and the flange and pipe covered with scale, rendering it difficult to make a good sound braze; sometimes powdered borax is sprinkled on, but it is very unsatisfactory.

The best and most economical method is, first carefully wash the brazing spelter in clear water, then mix a small quantity of granulated borax with the wet spelter and charge the flange before putting on the fire. The moist borax runs into the space between the flange and the pipe and keeps it chemically clean, and no trouble is experienced in making a good sound joint. Extra charging when the flange is at brazing heat should be avoided, but if necessitated by the flange collar not being sufficiently filled, the extra brazing spelter can be applied without the slightest need for stopping the blast, for the longer the copper pipe remains under heat the greater the effect of damaging gases and the more the molten spelter penetrates into and reduces the thickness and strength of the pipe. This latter effect is invariably the cause of many copper steam pipes prematurely weakening near the flange area. Smartness is the keynote of all successful brazing, as no time whatever must be lost during the process.

The use of coal-gas bunsen burners, or torches, is sometimes recommended for brazing flanges on pipes, but I do not recommend it for the following reasons: (1) The deleterious effect upon the brazing spelter of a fierce flame causes "perishing." This is found in practice by the large amount of borax necessary to flux the spelter and the "drossy" condition of the spelter after a few minutes' action upon it by the torch flame. (2) The fierce play of the torch flame upon the copper area immediately above the flange results in excessive and more or less prolonged heating. This part of the pipe should be particularly guarded from any prolonged heat. (3) The high cost of coal gas for blowpipe brazing. The indications of a good flange braze are neatness and clearness around the spelter on the flange collar. No filing at the collar should be permitted unless with a round file, as the tendency to file square corners is a frequent cause of premature "necking."

In an emergency a good practical method of repairing a badly worn or broken copper pipe is to cut the pipe through the center of the defect and then obtain a short length of copper piping which fits closely over the ends of the broken pipe to form a ferrule. When the job has been properly prepared, hold the pipe in a vertical position and begin brazing one end of the ferrule first. (The air-acetylene torch flame is very efficient for repair work of this kind.) Immediately the spelter has set, reverse the pipe and braze the other end in a similar manner.

Another method of repairing a ruptured or split copper pipe by brazing methods is to chip a triangular groove of the width and depth of the fracture with a sharp chisel. A piece of brass or copper wire is then laid in the groove and tightly secured by iron binding wire. The brazing is then done in the ordinary way.

When brazing with a forge fire, the best fuel to use is clean coke in small pieces. As already mentioned, borax is the flux used in brazing operations. Some mechanics, however, crush the lump borax into a fine powder and apply it in powdered form to the parts to be brazed. Others mix equal quantities of powdered borax and spelter together in clean water and apply the mixture. From my own experience I recommend the use of calcined borax, as it prevents the flux swelling and frothing up, as well as carrying away the spelter when the heat is first applied. Calcining is easily done by playing a torch flame upon the borax, when the latter swells up, and it can be rubbed down after it has cooled. Excessive use of flux, especially toward the end of the brazing operation, invariably results in a hard surface on the metal, which is extremely difficult to remove.

When brazing cast iron, a good flux can be made of boric acid 4 oz., pulverized chloride of potash 1 oz., and carbonate of iron 1 oz. This mixture should be kept dry, as moisture reduces its efficiency. Thoroughly mix this flux with spelter before starting the actual brazing. After the brazing operation allow the work to cool slowly. The best brazing solder for iron or steel products is brazing brass sheet cut up small.

Manchester, England. E. ANDREWS.

Comments from Readers

Heat Transfer in Brine Coolers

In *Power* of Dec. 8, 1925, under "Comments from Readers," M. R. Carpenter stated that where shell-type brine coolers are used, a transmission of 30 B.t.u. per sq.ft. per degree of temperature difference is secured, but that brine velocities must be and are very high.

It has been my experience that one is always safe in using a heat transfer of 70 B.t.u. per sq.ft. per degree temperature difference and in a great many brine-cooler ice plants 85 B.t.u. is common.

The low heat transfer obtainable in so many brine coolers is due to the universal method of operating the coolers with an insufficient ammonia charge.

New York City. R. T. BRIZZOLARA.

Changing a Two-Phase Winding for Three-Phase Operation

I read with considerable interest the article in the Nov. 24, 1925, issue on "Changing a Two-Phase Winding for Three-Phase Operation." I agree with Mr. Huskinson that the two-layer lap winding is more versatile than the concentric type, which admits of few changes by way of reconnection. However, Mr. Huskinson says, "Where a two-phase motor has a distributed winding, it can be reconnected for three-phase operation and rewinding may not be necessary," after which he mentions several methods of accomplishing this.

Why could he not also have regrouped the original 6-pole concentric winding for 8 poles and reconnected it 2 parallel Y when it would have been good for approximately 219 volts on a three-phase motor, and about three-fourths of its original rating or perhaps more, as the original motor seems to have been liberally designed with respect to copper? W. L. STEVENS.

New Westminster, B. C., Canada.

Notes on Auxiliary Drive

The development of stage feed-water heating and the unit system of boilers, turbine, generator and auxiliaries in recent power plants makes a unique opportunity for the small steam turbine. The boiler pressure for the main turbine is inconveniently high for the auxiliary turbine. But from an actual case, bled steam at 115 lb. gage plus 100 deg. superheat is used for feed-water heating, and a lower stage of the main turbine provides steam at 2 lb. gage. Suppose we insert auxiliary turbines between these two pressures. The available heat is about 150 B.t.u. per pound of steam, and if the potential efficiency, or ratio of available heat converted into work to available heat in steam used, is, for example, 37½ per cent, the steam rate will be 45 lb. Exhaust from the auxiliary will be superheated about 70 deg. and should be used so far as possible in feed-water heating to save the latent heat. Any excess may be run through the reheating boiler back into the main turbine at the bleeder connection and used in the vacuum stages.

This makes the heat efficiency, as part of the plant, very high, since so far as the small turbine is concerned, no heat is wasted except the small amount lost by radiation. In such installations the ability to start up a unit or the plant from a complete shutdown may be provided by a reducing valve to auxiliaries, by interconnecting the low-pressure steam lines or by one or more low-pressure boilers.

Recently, the demand has been made on the manufacturers to produce a more efficient small turbine. That can be done, although its relative economy has been creditable for a long time. Years ago and without my knowledge comparative tests were made at a Midwest state university between one of my first turbines and a non-condensing high-speed steam engine of the same power. Each ran at its own speed between the same limits of steam pressure. The test curves, when published, showed the turbine to have the lower water rate through the whole range of load.

The actual economy of the turbine is likely to depend chiefly on the driven machine, especially in case of centrifugal pumps or blowers. One of my early turbines went into condenser service driving direct a large centrifugal pump at 400 r.p.m. It was little better than a reducing valve in the steam line and developed not more than 20 per cent of full power at a given steam pressure. Over a wide range below the best speed, the steam rate for a turbine is nearly inversely proportional to the speed. Thus for a given steam pressure on the nozzles, a turbine may develop at 1,500 r.p.m. one-half the power of 3,000 to 3,600 r.p.m., while using the same weight of steam per hour. This is based on results of tests.

There are two ways at least of giving a steam turbine a chance to run at its best speed: First, by making the driven machine also a high-speed machine. Here is an actual case with direct drive. A small turbine developed 23 b.hp. at 3,000 r.p.m. between 80 lb. wet steam and atmospheric exhaust with a steam rate of 50 lb. With the available heat at 125 B.t.u., the potential efficiency is 40 per cent. The duty was to drive a circulating pump in a refrigerating plant. The pump, coupled to the turbine and driven at 3,000 r.p.m., showed an efficiency of 78 per cent at 750 gal. per min. and 60 ft. total head. Good engineering methods were used in testing both machines, and errors are small.

Are such high-speed runners durable? For a required discharge head the rim speed will be the same as for the low-speed runner, while the friction area is much smaller and the chance for high efficiency consequently greater. Recently I examined a runner that had been in municipal service four years at 3,000 r.p.m., delivering about 2,000 gal. per min. against 100 to 120 ft. total head. The blades were not worn and the contact surfaces of the double-acting hydraulic balance were untouched. I think the question of durability is mostly a matter of design and construction.

Then there is a phenomenon of which the runner working against high head may take advantage. At a rim speed said to be around 130 ft. per sec. (though that will depend on temperature) the surface of the runner tears away from the liquid and runs in a vapor envelope. The effect is to reduce the erosion on the runner and the power for driving. So the life is longer and the efficiency higher. The greatest use of this advantage is made by boiler-feed pumps handling hot water under a suction head.

The second way of giving the steam turbine a chance to run at its best speed is to use reduction gears, as in case of driving forced-speed blowers or large-volume, low-head circulating pumps. Even in those cases where gears are unavoidable, a high-speed impeller for blower or pump will permit a lower speed reduction with lower cost, and probably longer life of gears. For the high reductions entail a small pinion that concentrates the wear. At best the gears will make more noise and probably more trouble than either turbine or pump. The better policy wherever applicable is to build a high-speed pump or blower, thereby reducing weight and cost, and then drive direct by a turbine that will meet the driven machine on speed.

Then there is the matter of control. An operating engineer does not hesitate to run a boiler-feed piston pump on the throttle. No machine controls more easily by the throttle than the steam turbine. Then why embarrass it by a centrifugal governor and also an emergency governor? I have read of turbine failures due to neglect in keeping the emergency governor in order. Some years ago I saw in an Eastern power plant for a blast furnace the wreck of a turbine-driven pump caused by someone inadvertently setting a tin pail where it stopped the movement of the emergency governor lever. Besides, operating engineers usually have enough to do without looking after a lot of attachments.

But is it safe to operate a turbine without a governor? What would happen on a runaway? Such questions were asked me once by an engineer of tests for an underwriters' laboratory, and the answer was not ready. Afterward I turned full steam on a turbine designed to run at 3,600 r.p.m. and held a tachometer at the shaft. Without load the turbine ran up to 7,000 r.p.m., held it steady for a few minutes and then throttled down to normal speed without sign of distress. That was a four-stage turbine with two disks per stage. The kinetic efficiency is higher in the second disk than the first of a stage, so the second disk soon begins to pull back on runaway. The result is a firmly set speed limit for a given turbine and set of conditions. This effect is more pronounced with three disks per stage than for two. A turbine with one disk per stage will run up to full speed with lower steam pressure and may have a lower steam rate at light load than one with two or three disks per stage, but the runaway limit is higher. As turbines driving pumps or blowers usually work from half load to full load, the economy at light load is not of much importance.

After all, the danger of runaway with a turbine driving a blower is small. The blower is always primed, the power required runs up with the cube of the speed, so the turbine will not get far. The same is true of a pump that is always primed. Then, in case of the pump, the discharge pressure in the volute around the impeller tends to relieve the centrifugal stress, and further the diameter is usually small compared with the turbine disk.

The position of the small steam turbine as a standard of comparison for reliability is clearly indicated in a report of the Prime Movers Committee of the N.E.L.A. in stating the decision of certain companies that "balanced relay protection" is sufficient to enable motor-driven auxiliaries to furnish a type of service comparable with that of steam-driven auxiliaries. In an earlier report for this year, the committee states that of 28 central stations investigated, 21 have steam pumps in whole or in part and only 7 have motor-driven pumps alone.

It will help the small turbine some in maintaining its position as a standard if centrifugal and emergency governors are left off wherever practicable, thus making it a machine with main bearings only. Simplicity and reliability, steady flow of exhaust free from oil, ease of control and a saving of relatively cheap steam in proportion to reduction of speed, are three pairs of advantages for auxiliary drive held by the small steam turbine. Against the motor especially, the small turbine holds the permanent advantage that the selling value of current, involving, as it must, more of labor and capital charges, is always greater than the cost of steam producing it.

C. V. KERR.

Los Angeles, Calif.

Boiler Performance Based on Heat of Combustion Gases

The August 25, 1925, issue of *Power* contained a comprehensive abstract of a paper entitled "Boiler Performance Based on Heat Content of Combustion Gases," by W. H. Jacobi. This was an effort in the right direction. Over-all boiler efficiency depends on two principal factors—combustion efficiency and absorbtion efficiency. The economic performance of a boiler as such, can be properly based only on the latter. It is obvious also that the boiler should not be charged with heat not available to it.

Mr. Jacobi proposed the following formula:

$$\frac{S \times (H - h) \times 100}{G \times (H_1 - h_1)} = \textit{per cent boiler efficiency}$$

where

S = The weight of steam produced per pound of fuel fired;

H = B.t.u. contained in one pound of steam;

h = B.t.u. contained in one pound of feed water;

G = The weight of gas produced per pound of fuel fired;

H_1 = B.t.u. liberated by combustion per pound of gas (this heat is all assumed to reside in the gas);

h_1 = B.t.u. per pound contained in the gas at the temperature of the boiler.

$S \times (H - h)$ = the heat contained in the steam produced per pound of fuel fired minus the heat brought into the boiler by the feed water. (It is that portion of the heat liberated by combustion, which is absorbed by the boiler. Since it matters not whether the heat in the fuel is transferred to the boiler by radiation or convection, the editorial criticism in the Sept. 1, 1925, issue of *Power* does not apply.)

$G \times (H_1 - h_1)$ = that part of the heat contained in the gas which is available to the boiler.

To determine the numerical values of the factors involved in Mr. Jacobi's formula, it is necessary to have all the data required to carry out the conventional heat-balance test, namely, the ultimate analysis of the fuel

and its heating value, complete analysis and temperature of the flue gas, weight of fuel burned, weight of water evaporated, temperature of the feed water, quality of the steam—also the carbon contained in the ash, and the air temperature. To determine these factors an elaborate boiler test must be made.

It is obvious that the greater the number of quantities to be observed and averaged up and the more complex the formulas for calculating the results, the greater will be the probability of error. The difficulty of getting a true average sample of any large quantity of coal is also well known. Duplicate samples rarely agree within one per cent in their heating value; differences of over 2 per cent are frequent.

The writer has demonstrated elsewhere that the "P.C." fuel unit, that is, a weight of fuel containing one pound of carbon, represents a practically constant heat value for each of the several classes of fuel. The heating value H_s of the P.C. fuel unit is 14,550 + 62,000 H_a, where H_a = the average weight of available hydrogen per pound of carbon contained in the fuel. The value of H_s may be taken as 17,900 B.t.u. for bituminous coal.

The following two formulas give practically identical results:

$$\frac{S \times (H - h) \times 100}{G \times (H_1 - h_1)} = \frac{\textit{heat absorbed by the boiler} \times 100}{\textit{available heat liberated by combustion}} = \textit{per cent boiler efficiency} \quad (1)$$

$$\frac{AHW}{HL} = \frac{\textit{available heat wasted}}{\textit{heat liberated by combustion}}; \text{ hence}$$

$$100 - \frac{AHW \times 100}{HL} = \textit{per cent boiler efficiency} \quad (2)$$

To determine the boiler efficiency by formula (2) the following few data will suffice:

CO_2 = Average per cent of CO_2 during test;
CO = Average per cent of CO during test;
T = Average temperature of gas on leaving boiler;
T_w = Average temperature of water in boiler derived from average steam pressure;
C_a = Per cent of carbon in ash.

To apply the formulas we will take the following data and results obtained in an expert boiler test carried out in the most elaborate and careful manner.

TEST DATA

Ultimate Analysis of Coal

C	H	O	N	S	Ash	B.t.u.
76.94	5.35	8.22	1.11	1.38	7.00	13,896

Analysis of Flue Gas, per Cent

CO_2	CO	O	N	Carbon in Ash, per cent
14.40	0.35	5.54	79.71	31.6

Temperatures (deg. F.)

Gas Leaving Boiler	Saturated Steam	Superheated Steam
483	383	490

Pressure, etc.

Steam Pressure	Rate of Driving
199 lb.	94 per cent

Test Results

Per cent of heat in coal absorbed by boiler (conventional boiler efficiency)	81.15
Per cent of heat lost:	
Heat in dry gas	9.11
Heat in flue-gas moisture	4.65
Heat loss due to CO	1.29
Heat loss due to carbon in ash	2.29
Heat loss charged to radiation	1.51
	100.00

All the data required to determine the boiler efficiency according to Mr. Jacobi's formula are not at hand, but by figuring back from the test results it will be found that the boiler efficiency in this case was 97.05 per cent.

Calculating boiler efficiency by the Uehling formula (wherein AHW = available heat wasted, and H_t = total hydrogen, both per P.C. unit), we have:

$$AHW = \left[(T - T_w \times \left(0.24 + \frac{58.46}{CO_2}\right)\right] + [(T - T_w) \times 4.3 H_t]$$

$$= \left[(483 - 383) \times \left(0.24 + \frac{58.46}{14.4}\right)\right] + [(483 - 383) \times 4.3 \times 0.072]$$

$$= 430 + 31 = 461 \text{ B.t.u.}$$

The CO contained accounts for 1.29 per cent, and the carbon in the ash contained 2.29 per cent of the heat in the coal fired. Hence HL = 17,900 — (17,900 × 0.0358) = 17,259 B.t.u. We then have:

$$100 - \frac{AHW \times 100}{HL} = 100 - \frac{461 \times 100}{17{,}259}$$

= 97.33 per cent boiler efficiency.

This agrees within 0.3 per cent of the efficiency found by the much more complicated method and because of the few data required and the simple formulas involved is probably the more nearly correct result.

Milwaukee, Wis. E. A. UEHLING.

Checking Watt-Hour Meters with a Rotating Standard

Regarding the criticism by W. D. Wilkinson in Nov. 24 issue, of my article on the subject of testing watt-hour meters on connected load in the Sept. 15 issue, it may be stated that this article was written not so much from the viewpoint of adjusting a meter in all its phases as it was to instruct the operating man how to connect and determine the as-found accuracy of a meter when the only equipment available is a rotating standard. Mention is made of the full- and light-load adjustments of the meter because they are the most common adjustments that have to be made. Owing to the fact that the balance-of-elements and power-factor adjustments are set quite close by the meter manufacturers, these adustments are usually within 1½ per cent accuracy, and therefore I felt safe in saying that the lower element would be about the same percentage slow as the upper element.

The importance of having the elements of a meter closely balanced is realized and it might be added that the power-factor adjustment of each element is also important; therefore, I do not believe it advisable to attempt to instruct an operating man in the making of these adjustments on connected load, but rather would advise him to call in an experienced meter man or refer to the manufacturer for the necessary information, as was suggested in the last paragraph of the article.

With reference to the statement on page 402, "These light-load adjustments affect only the element that is being adjusted," it was made as a comparison against the retarding-magnet adjustment referred to in the preceding paragraph of the article so as to indicate that an adjustment of the light-load plate of one element would not affect the independent light-load accuracy of the other element in the same sense that an adjustment of one of the magnets on one element would affect the accuracy of the other element. I believe that every operating man realizes that any one adjustment of a meter, no matter on what coil, would affect the percentage registration of the meter as a whole.

Poughkeepsie, N. Y. WILLARD F. WALSH,
System Meter Supervisor,
Central Hudson Gas & Electric Co.

New and Improved Equipment

Wright-Austin Extra Heavy Water Gage and Try-Cock

The Wright-Austin Co., Detroit, Mich., has recently extended its line of boiler accessories by the addition of an extra-heavy water gage and try-cock shown in the accompanying illustrations. The water gage, Fig. 1, is similar to the standard line of water gages made by this company except that it is of extra-heavy construction and is fitted with gage-glass washers of a special composition to meet the requirements imposed by the higher pressures carried. The try-cock, Fig. 2, is of the weighted-type, opening by chain pull and closing with the weight. The valve and seat are made of monel metal, and each is reversible so that the length of service is greatly increased before regrinding becomes necessary. The valve and seat can also be renewed or reversed without removing the try-cock from the boiler, which greatly facilitates the making of repairs. A friction washer permits the adjustment of the weight to any angle desired. On types of try-cocks used on pressures up to 250 lb., the stem is made of brass, but for higher pressures is made of monel metal or steel.

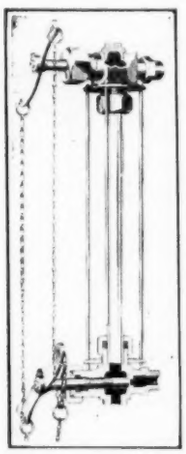


Fig. 1—Extra-heavy water gage

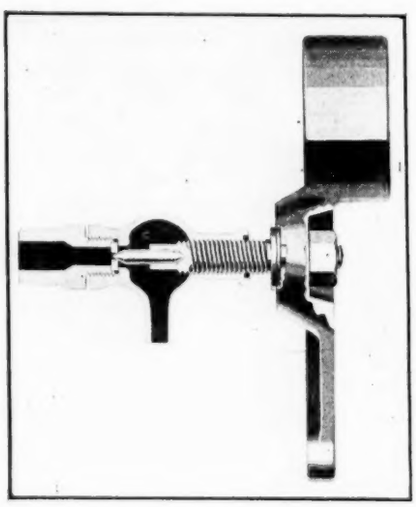


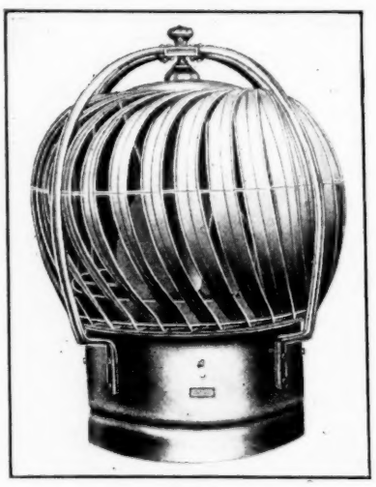
Fig. 2—Weighted try-cock with reversible valve and seat

The weight used on the try-cock is cast in one piece and is designed so that when three try-cocks are in position on a water column, they can be opened wide without the weights interfering with one another even though closely centered.

Improved Allen Ventilator

Recent improvements to the line of ventilators made by the Allen Air-Turbine Ventilator Co., Detroit, Mich., include a redesigning of the rotor to obtain greater discharge capacity than was possible with the older type of ventilator and also the use of an improved type of bearing with a view to increasing the efficiency and decreasing the amount of attention necessary to keep the bearings properly lubricated.

The new rotor consists of a combination cone with multi-vane construction carried on a steel shaft having a simple point bearing housed in a cast-iron hub which is supported in the base of the ventilator. The top part of the shaft is equipped with a bronze guide bearing that is so designed that in cases of excessive wind velocities and high speed of the rotor the tapered end of the shaft is forced upward into a tapered part of the bearing, which tends to retard the speed of the rotor. The bearing is supported by four arms carried from the base of the ventilator, as shown. Both bearings are designed with chambers to hold a quantity of lubricant, and each is equipped with pressure-lubricating connections.



Improved multi-vane ventilator

The ventilator is built of galvanized metal coated with a special compound to lessen the action of the weather and acid fumes. It is also made of cold-rolled copper. The ventilator is built in sizes from 8 to 48 in. and is claimed by the manufacturer to have an air displacement, at a wind velocity of 4 miles per hour, of 17,300 to 360,000 cu.ft. and at a velocity of 8 miles per hour, from 21,600 to 473,000 cu.ft. per hour.

Vogt Combination Vertical and Horizontal Check Valves

Combination vertical and horizontal check valves designed for use with oil and non-corrosive fluids, operating under pressures up to 600 lb., with temperatures of 1,100 deg. F., have been brought out recently by the Henry Vogt Machine Co., Louisville, Ky.

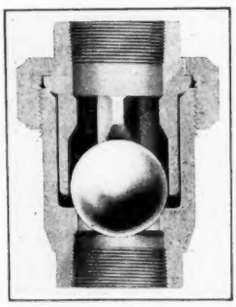


Fig. 1—Union-bonnet screw-end valve

The union-bonnet screw-end valve shown in Fig. 1 is made in sizes from ½ to 2 in. The bolted-body flanged-end valve shown in Fig. 2 is made in sizes from ½ to 3 in. In the larger valve (Fig. 2) the body and flanges are of drop-forged steel and the removable seat is either cold-rolled steel or monel metal as required. The guide pins for the steel ball are cold-rolled steel, and the employment of these pins makes it possible to use the valve in either a vertical or horizontal position. One end of each guide pin rests in a recess machined in the valve body, while the other end is carried in a yoke clamped between the body flanges.

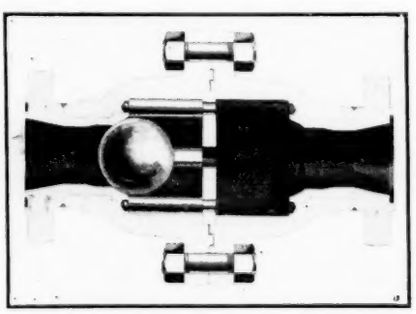


Fig. 2—Flanged combination check valve

Blaw-Knox Regenerative Air Heater

An air heater of the continuous regenerative type, a view of which is shown in Fig. 1, is a recent development of the Blaw-Knox Co., Pittsburgh, Pa. The heater consists essentially of three compartments containing the heating elements, valves for controlling the admission of the gas and air to the chambers intermittently, together with regulating mechanism and suitable flues for conducting the air and gas to and from the heating elements. The heater is adaptable to uses in the industrial-plant field as well as for preheating air for the boiler furnace.

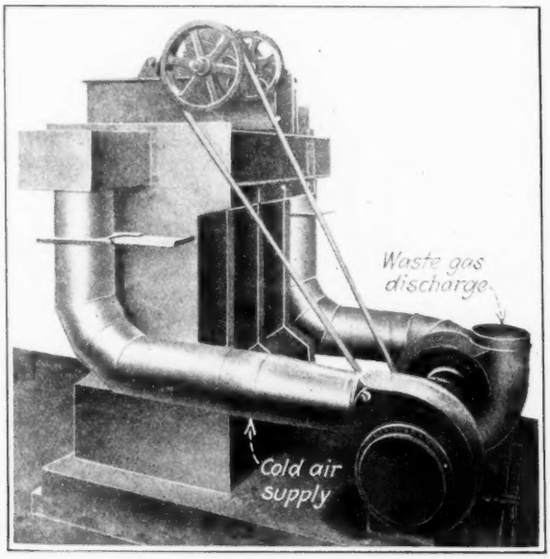


Fig. 1—Typical installation of a small unit

In Fig. 2 is shown a general arrangement of the heater. Referring to the lower right-hand view, it will be seen that the valves are connected in pairs. The hot waste gases enter the lower right flue and pass up into the chamber in which the right-hand pair of valves are open and pass out through the upper right-hand flue. In passing through the chamber, the heat is transferred to the heating elements, which consists of $\frac{1}{16}$-in. steel plates placed about $\frac{1}{4}$ in. apart. The cooled waste gases are discharged to the boiler flue or some other point by an exhauster. The air enters the upper left-hand flue from a fan and passes into the chambers in which the left-hand pair of valves are open and extracts the heat from the steel plates and then leaves the heater through the left-hand bottom flue. The valves are operated continuously by a slowly revolving camshaft on the top of the heater. There is one cam for each chamber, and the cams work against rollers on a double rocker which lifts alternately the air valves and the gas valves.

The movements of the valves are shown by the diagram at the upper right in Fig. 2. It will be seen that for 60 deg. turn of the camshaft, the valves are raised and that they are stationary for 60 deg. and that they close during another 60 deg. It will also be seen that the gas and air valves for the same chamber are never open at the same time and that the movements of the valves in the three chambers are such that at any one moment there are openings corresponding to one full valve opening either for waste gas or for air and that all the heating surface of the heater is always in use. The flow of air and waste gases through the heater is therefore continuous, and the movement of the valves is so slow that no shocks occur from either opening or closing the valves. The heater is provided with numerous cleaning doors both in the chambers and in the upper and lower flues, as well as with doors for installing and inspecting the steel plates. Suitable soot doors can also be easily arranged for cleaning the spaces between the plates.

It is claimed by the manufacturer that leakage in this type of heater is small, being practically limited to the free volume of the chambers which is lost at each reversal. This loss amounts to about 1 to 2 per cent of the air. Also, the resistance of waste gases and air through the heater can be kept as low as desired.

The thickness and the material of the heating elements can be changed to suit different conditions as well as the opening between the sheets. The heater occupies a comparatively small space, and it is built to preheat the air to within about 125 deg. of the temperature of waste gases from the boilers. It is manufactured in eight sizes for heating from 5,000 to 130,000 lb. of air per hour. For higher capacities it is proposed to build a five-chamber unit which, for the same size of valves, will have double the capacity.

The heater is manufactured in accordance with patents issued to Waldemar Dyrssen, assignor to the Blaw-Knox Co. It is being handled by the Blaw-Knox Co. in the general industrial field and by The Power Specialty Co., 111 Broadway, New York City, in the central-station field.

"Brickset" is the name of a high-temperature cement now being produced by the Chicago Fire Brick Co., 111 West Washington St., Chicago, Ill. It is a natural flint clay bonding material having approximately the same coefficient of expansion and contraction as the electric furnace firebrick made by this company. When wanted for use, it is mixed to the consistency of soup, and the bricks are dipped, then tapped into place with a mallet.

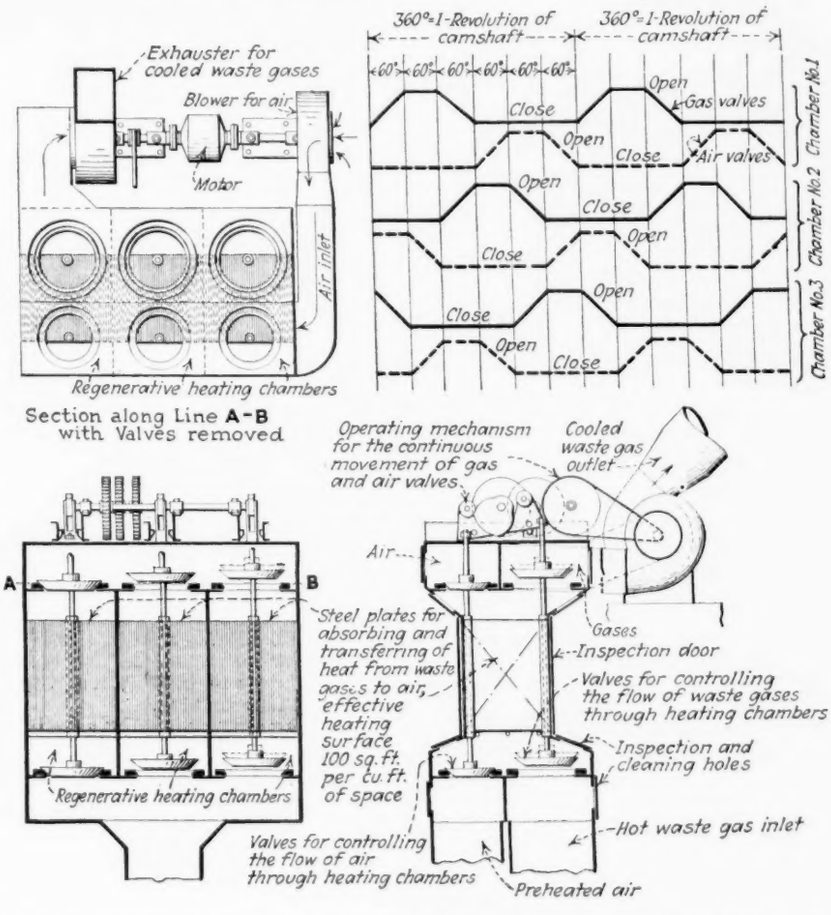

360°=1-Revolution of camshaft
360°=1-Revolution of camshaft
60° 60° 60° 60° 60° 60°
Exhauster for cooled waste gases
Blower for air
Motor
Air inlet
Regenerative heating chambers
Open
Close
Gas valves
Air valves
Chamber No.1
Chamber No.2
Chamber No.3
Section along Line A-B with Valves removed
A
B
Regenerative heating chambers
Operating mechanism for the continuous movement of gas and air valves.
Cooled waste gas outlet
Air
Steel plates for absorbing and transferring of heat from waste gases to air, effective heating surface 100 sq. ft. per cu. ft. of space
Gases
Inspection door
Valves for controlling the flow of waste gases through heating chambers
Inspection and cleaning holes
Hot waste gas inlet
Valves for controlling the flow of air through heating chambers
Preheated air

Fig. 2—Details of heater and chart showing relative movements of the valves

News in the Field of Power

Colorado River Construction Program of Administration Outlined

Boulder Canyon Reservoir Would Cost $41,500,000 and All-American Canal $31,000,000—Main Source of Revenue Will Be from Power —Unified Power Plant Advocated Instead of Allocation of Power

THE administration has outlined its Colorado River policy in a report made by the Secretary of the Interior on the Swing-Johnson bill. The report was made, it is understood, after Secretaries Work and Hoover had discussed the matter at length with the President.

The report recommends the construction, with federal funds, of a dam in the Colorado River to be 550 ft. high, which will create a reservoir of 26,000,000 acre-feet capacity. The all-American canal, connecting the Colorado River with the Imperial and Coachella Valleys, is held to be an essential part of the plan.

The electrical energy that will be developed in connection with the project, should be sold, the report says, at the switchboard, to the highest bidder. The purchasers of the power will be in entire charge of distribution, and they must provide their own transmission lines. A unified power plant, Doctor Work contends, is better than the allocation of power privileges as proposed in the Swing-Johnson bill. Joint use of trunk transmission lines, it is pointed out, is no longer an experiment.

The benefits of the development under the Administration plan are to be available only to the states that ratify the Colorado River compact.

The report says:

> Interstate and international rights and interests involved, the diversified benefits which will flow from the construction of these works, the waiting necessities of cities for increased water supplies, the large development of latent agricultural resources, the protection of those already developed and the immense industrial benefits which will come from the production of cheap power appear to render desirable the construction and subsequent control of these works by the federal government. All uses can be co-ordinated and the fullest benefits realized only by centralized ownership and control.

With regard to the sale of water for agricultural and municipal purposes the report says:

> In the sale of water to irrigation districts and municipalities the prices of water should be such as to repay all operating expenses and return the money expended on the all-American canal within the period fixed in the Reclamation Act and under its conditions.
>
> The necessity for the all-American canal and the size and cost of this canal depend largely on whether the existing concession, under which water now is diverted from the Colorado and carried through Mexico to the Imperial Valley, can be modified. If it cannot be, the all-American canal becomes an indispensable part of the project.
>
> If the government of Mexico would consent to a modification of the concession and limit definitely the volume of water to which Mexican irrigators would be entitled, then the future use of the present canal would be economical and desirable. The all-American canal could be made smaller and used mainly for the irrigation of the higher lands in the Imperial and Coachella Valleys.
>
> As the Mexican irrigators are on the upper end of the present canal, the pinch of scarcity when it has come in the past or when it may come in the future, falls first on irrigators in the United States, the country that supplies all the water, all the construction cost and all the money advanced for operations. It is unfair to California irrigators now and will be even more unfair after the reservoir is provided.

The reservoir in Boulder Canyon, Secretary Work figures, will cost $41,500,000. To develop 1,000,000 hp. of electrical energy will cost $31,600,000, it is estimated. The cost of the all-American canal is placed at $31,000,000.

The main source of revenue will come from the sale of power. Wholesale prices of power in the West now range from three and one-half mills to eight mills per kilowatt-hour, measured at the switchboard, it is declared. Assuming that only three mills will be realized the revenue would amount to $10,800,000 annually, it is calculated, as 3,600,000,000 kw.-hr. would be generated. Storage and sale of water for irrigation and domestic purposes would net $1,500,000. Operation, maintenance and fixed charges would be $6,000,000 annually, Secretary Work says. Repayment of the entire federal expenditures therefore would be possible in twenty-five years.

It is recommended further that the construction work be placed in the hands of the Reclamation Bureau.

John Fritz Gold Medal Awarded to E. D. Adams

Award of the John Fritz Gold Medal to Edward Dean Adams, of New York City, for achievement as "an engineer, financier, scientist, whose vision courage and industry made possible the birth at Niagara Falls of hydro-electric power," is announced by the Engineering Foundation.

"This medal," the announcement says, "was established in 1902 in honor of John Fritz, pioneer in the American iron and steel industry. It is bestowed annually for notable scientific or industrial achievement and is the highest honor bestowed by the engineering profession in this country.

"The award was made by a board of sixteen representatives of the American Societies of Civil, Mining and Metallurgical, Mechanical and Electrical Engineers, having a total membership of 53,000.

"Edward Dean Adams was graduated as a bachelor of science from Norwich University in 1864 and afterward pursued engineering studies at Massachusetts Institute of Technology.

"He has been a fellow of American Society of Civil Engineers since 1891, an associate of American Institute of Electrical Engineers since 1910, vice-chairman of the Engineering Foundation from its beginning, and for years an active member and officer of the Engineering Societies Library.

"It was on his decision that alternating current was chosen for the epoch-making plant of the Niagara Falls Power Co. in 1891 and for the transmission of the power by wire to Buffalo. Personally, he made extensive studies of the latest forms of electric generators and water turbines in Europe and America.

"He adhered to his momentous decision on the kind of electric current and equipment to be used in spite of contrary opinions emphabetically expressed by Edison and Sir William Thomson (later Lord Kelvin). Now alternating current and direct-connected hydro-electric units are almost universally employed for power development and transmission.

Crude-Oil Production Still Declines

The daily average gross crude-oil production in the United States decreased 16,200 bbl. for the week ended Jan. 16, totaling 1,947,600 bbl., according to the weekly summary of the American Petroleum Institute. The daily average production of Smackover Arkansas heavy oil field increased 600 bbl. The daily average production in the United States, excluding Smackover heavy decreased 16,800 bbl. The daily average production east of California was 1,328,100 bbl., a decrease of 6,700.

Daily average imports of petroleum at principal ports for the week ended Jan. 16 were 197,571 bbl. compared with 166,571 for the previous week and 167,107 for the four weeks ended January 16.

Washington, D. C., Central Power Plant To Be Studied

A study of the central power-plant situation in Washington, D. C., has been ordered by Gen. H. C. Smither, the chief co-ordinator of the Bureau of the Budget. Before the war considerable expense was incurred in laying conduits and making other preparations for a central plant to serve all government buildings. The question now has arisen as to the salvage of this property.

Consideration will be given the completion of the original project, which may be the only means of utilizing the work already done.

The study will be made by a committee which probably will consist of Dr. O. P. Hood of the Bureau of Mines, Dr. H. C. Dickinson of the Bureau of Standards and Capt. R. G. Klotz, engineer of the District of Columbia Public Utility Commission.

Portland, Ore., Plants To Have Additions

Among the items included in the 1926 budget of the Portland Electric Power Co., which included appropriations of $2,400,000 for the electric light and power department, are the installation of a 20,000-kw. steam turbine at Station L in Portland, at a cost of $560,000, and $150,000 for modernizing equipment in the Oregon City hydro-electric plant.

Spokane Gets Lower Electricity Rates

Widespread rate reductions supplying a blanket rate for all towns on the system of the Washington Water Power Co. outside of Spokane and revising rates within Spokane and the Spokane Valley district were filed with the Washington and Idaho state officials on Jan. 8. A new Spokane residential rate of 5½c. for the first 32 kw.-hr. and 3c. for additional consumption replaced the former rate of 7c. for the first 20 kw.-hr. and then 3c. The minimum of 70c. per month remains. Reductions in commercial lighting rates are also made within Spokane. In the 52 cities and towns outside of Spokane served by the company widely varied rates are replaced by new tariffs. The new suburban residential rate in this territory is 34 kw.-hr. at 8c. and additional consumption at 3c.

American Engineering Council Elects Kimball President

Dean Dexter S. Kimball, of Cornell University, was elected president of the American Engineering Council at the annual meeting of the Council at the Mayflower Hotel in Washington, Jan. 13-15. Dean Kimball, past president of the A.S.M.E. succeeds former Governor James Hartness of Vermont.

Gardner S. Williams, of Ann Arbor, Mich., and Irving E. Moultrop, of Boston, were named vice-presidents. Mr. Williams being re-elected. Dr. Harrison E. Howe, of Washington, was re-elected treasurer, and Lawrence W. Wallace, of Washington, was again chosen executive secretary, a post he has held since the organization of the Council.

Approval was given to a public works bill to be introduced in the Senate by Wesley L. Jones, of Washington, and in the House by Adam M. Wyant, of Pennsylvania.

Eight engineering studies, delving into conditions on the nation's farms and factories and among the workers, were proposed in a report of a Special Research Committee of the Council, of which Doctor Howe, who is editor of the official journal of the American Chemical Society, is chairman. This report was approved by the Council.

The cost of the research is estimated at $335,000 by the committee, other members of which are L. P. Alford, of New York, representing the American Society of Mechanical Engineers; E. S. Coudrick, New York, Society of Industrial Engineers; Ray M. Hudson, Chief of the Division of Simplified Practice, Department of Commerce, and Lawrence W. Wallace, of Washington.

Early Consideration of House Resolution on Muscle Shoals Problem Not Expected

Senator Heflin Insistent on Action for Bids by Joint Committee—Hoover Anxious for Action—Union Carbide Co. Favors Taking Tennessee River Out from Power Act

EARLY consideration of the House Muscle Shoals resolution hardly can be undertaken, Senator Norris stated Tuesday, Jan. 19. So many matters are crowding upon the Agricultural Committee, he said, that five or six weeks might elapse before it could be disposed of.

Insistent efforts were made at the Tuesday meeting of the Committee by Senator Heflin of Alabama to secure action on the resolution, which provides for a joint congressional committee to receive bids for the Muscle Shoals properties, as reported on page 76, Jan. 12 issue.

Senator Norris said it would require more time to dispose of the resolution than the Committee could give now.

It is expected that the Committee will eliminate the reference to the Ford offer, but is likely to approve the proposal otherwise.

In the meantime Senator Smith of South Carolina has come forward with a proposal that seems to appeal to many members of the upper House. He suggests that nothing be done with Muscle Shoals until more is known about the commercial possibilities of the processes of nitrogen fixation. He would have the government conduct experiments at Muscle Shoals allowing the surplus power go into distribution in the Southwest. The returns from the sale of the power would be used to finance the large-scale experiments, which would be conducted by a commission to be appointed by the Secretaries of War and Agriculture.

Synthetic nitrogen production is in a purely experimental stage so far as its commercial possibilities are concerned. Senator Smith says he fears, if the properties are leased to private interests, that the latter will be unwilling to put into the experiment sufficient money to carry them to success. Power development is a definite quantity, he said, and this factor need concern the government but little. The bill fixes no limit of time during which the experiments with nitrogen are to be concluded. The commission is to report to Congress whenever it considers a commercial basis of production has been reached.

Hoover Says Delay Retards Nitrate Production

Secretary Hoover, appearing again before the House Committee investigating foreign monopolies, said some definite action should be taken as to nitrogen production at Muscle Shoals, as the uncertainty is retarding the development of nitrogen fixation by private interests.

Since the Smith proposal offers middle ground between the Norris plan for government operation and the other extreme of turning the properties over to a single bidder, it would seem to have a fair chance to get through the Senate.

The Military Affairs Committee of the House, however, is manifesting impatience. Apparently, it is not willing to leave to others the matter in which it heretofore has taken such a prominent part. It is fully expected that the committee will undertake to secure the initiative again by bringing out a bill of its own.

Hearings on Tennessee River and Water Power Act Over

The hearings on the Norris resolution proposing to take the Tennessee River out from under the Water Power Act as reported in the Jan. 12 issue, page 79, were concluded Tuesday. Leonard H. Davis, of the Union Carbide Co., appeared to support the Norris resolution. He explained that the Union Carbide Co. had been a bidder for Muscle Shoals and expected to submit another bid for the properties. For that reason, he said, his company is interested in seeing the development above co-ordinated with that of Muscle Shoals. He suggested that the resolution should apply to preliminary permits as well as to licenses. Senator Norris agreed to make that change in his resolution.

One of the outstanding features of the hearing has been the testimony showing the loss of confidence in the ability of Congress to deal effectively with business propositions as a result of the long delay in agreeing on a policy for the disposition of Muscle Shoals.

North Carolina Power Company Protests Pigeon River Delay

Witnesses from Asheville and western North Carolina pointed out the acute need for more power and protested vigorously against interference with the plans of private enterprise. They were interested particularly in preventing any delay in the granting of rights to the Pigeon River Power Co. Julius Martin, the attorney for that company told the committee that they had expended $450,000 in the purchase of land and in making surveys to comply with the terms of the preliminary permit. Senator Norris said he is willing to except the companies that actually have expended money in perfecting their rights.

Senator Norris, during the course of the hearing referred to Alabama as being in the grasp of the Alabama Power Co. This brought the prompt rejoinder from Senator Heflin that he had received no complaints against the Alabama Power Co. and its rates, fixed by the Public Service Commission of the state. Significance is attached to the defense of the Alabama Power Co. by Senator Heflin. It is thought to reflect the changed public attitude of the South toward the power companies. Senator Norris has issued another statement giving his view of the conflict over Muscle Shoals operation by private interests or by the government.

New England Power Interests Combine

Organization of a superpower corporation, involving close to $100,000,000, and designed to bring the hydro-electric power resources east of Niagara Falls into a co-ordinated production, was completed in Boston on Jan. 16.

To make this possible the New England Co., a holding corporation, will be reorganized under the name of the New England Power Association.

Final steps in the merger were completed when stockholders of the New England Co. approved the reorganization plans whereby $20,000,000 of new capital was made available for new plants and equipment.

Included in the merger which will provide the financial machinery through which the development of the hydro-electric power facilities will be sponsored, are the firms of the International Securities Co., F. L. Carlisle & Co., affiliated with the Power Corporation of New York, Stone & Webster, Inc., of Boston, and the International Paper Company.

Marine Engineers' Beneficial Association Meeting

The fifty-first annual convention of the Marine Engineers' Beneficial Association was held at the Franklin Square Hotel, Washington, D. C., during the week of Jan. 18. Delegates were in attendance from all sections of the country, including the northern and southern Atlantic, Gulf, Lakes and Pacific Coast.

Entertainment features consisted of an auto trip, a reception, a theater party and a banquet at which the speakers were Hon. James J. Davis, United States Secretary of Labor, T. V. O'Connor, chairman, United States Shipping Board, Admiral W. S. Benson, commissioner, United States Shipping Board, Gen. George Uhler, retiring Inspector General of the United States Steamboat Inspection Service, Donald Richberg, William F. Yates, past-president of the M.E.B.A. and William S. Brown the retiring president.

The election of officers resulted in the choice of: William F. Yates, New York City, president; D. W. Miller, Seattle, first vice-president; William H. Hyman, Baltimore, second vice-president; George Harrison, Galveston, third vice-president; A. L. Jones, Detroit, secretary-treasurer. The executive committee is: W. S. Hyman, Baltimore, for Atlantic Coast District; D. W. Miller, Seattle, for the Pacific Coast District; S. J. Hogan, Algeria, Ala., for the Gulf District; C. M. Sheplar, Pittsburgh, Western Rivers District; William S. Brown, Geneva, N. Y., for the Great Lakes District. Other officers appointive for this convention only were: William L. Bridges, Milwaukee, chaplain; Edward Clark, Buffalo, conductor; William Ellis, Washington, D. C., doorkeeper.

On Thursday the members of the convention were received at the White House by President Coolidge.

Chicago Diversion Arouses Ire of Harbor Association

A broadside of criticism against diversion at Chicago of 10,000 cu.ft.-sec. of Lake Michigan water issued from the convention of the Great Lakes Harbor Association, recently held at Detroit, Mich. Representatives of the legal departments of Ohio, Michigan, Minnesota, Wisconsin, New York and Indiana formulated plans for carrying on the fight against the diversion.

Francis King, of Kingston, Ont., a representative of the Dominion Maritime Association, told the 500 delegates attending the protest meeting that American supporters of the Lakes-to-the-Sea Waterway through the St. Lawrence River can expect no co-operation from the Government of Canada as long as Chicago is permitted to divert the lake waters for her drainage canal.

"No one can suggest that Canada would be unreasonable in declining to embark on any expenditure for the further development of the St. Lawrence River until this leak at Chicago is stopped," Mr. King said.

Cornelius Corcoran, president of the Milwaukee City Council, charged that Chicago wants the additional flow of water so that "she can continue to sell upward of $1,000,000 worth of water power annually."

Herman L. Ekern, attorney-general of Wisconsin, and Daniel W. Hoan, Mayor of Milwaukee, were other speakers. Mayor Hoan said that Chicago could build an adequate sewage-disposal system for $46,000,000, and that the present disposal system causes a loss of $100,000,000 annually.

Harvey D. Goulder, former general counsel for the Lake Carriers' Association, declared that there had been a six-inch drop in the level of water at the Soo locks in the last year.

"Any draft lost by a ship means a reduction in its carrying capacity. Last season alone the carriers suffered a $3,000,000 loss in business because of reduced cargoes," Mr. Goulder said.

An appeal will be taken to the Attorney General of the United States in an effort to obtain "immediate action" on the part of the government to stop the water diversion, it was announced. At the suggestion of Canadian delegates, it was decided to stress the treaty rights between Canada and the United States, said to be violated by the present diversion, in an appeal to the federal government.

Great-Lakes Waterway Organizes for Action

An organized demand for the Great-Lakes-St. Lawrence Waterway was started at the Great-Lakes Tidewater Association Congress which was held at St. Paul recently. New York state was scored at this meeting as being ungenerous in its attitude toward this development.

H. C. Gardner, of Chicago, president of the congress, said: "The cry from New York, against improvement of the St. Lawrence route because it would build up the port of Montreal at the expense of the port of New York was ludicrous when Montreal at the same time was crying aloud that theirs would become a port of call, that the fair-minded public in both controversies accepted neither plea as genuine.

Quebec Wants American Capital but Opposes Power Export

During the progress of the debate in the Quebec legislature on the question of power development in that province, Premier Taschereau clearly stated the government's policy on two points. One was that the government was unalterably opposed to the export of electrical energy to the United States; and the other was that the government was prepared to offer every facility to American capital to come in and aid in the development of the various power sites and to help in building up vast industries.

Defending the government's policy, the premier pointed to the marvelous results achieved at Shawinigan Falls and Grand Mere, Three Rivers, La Tuque, Kenogami and Jonquieres, and in the Eastern townships where American capital has aided in building up vast industries. "Criticism has not been lacking," he said, "but events have already commenced to show that we are correct."

Dealing with the regulation regarding power export, the premier said: "We are Canadians and will always be disposed to permit the exportation of our electric energy to the sister provinces. In a short time we will come to an understanding with them, and we are disposed to develop all hydraulic power on bordering waters for the mutual advantage of the two provinces. We especially invite the province of Ontario to rap at our door. It will be opened to them widely."

Production of Bituminous Coal, January-November, 1925, and 1919-1924*

In Thousand Net Tons

	1925	1924	1923	1922	1921	1920	1919
January	51,930	52,507	51,944	38,930	41,148	49,748	42,193
February	38,987	47,302	43,645	42,425	31,524	41,055	32,103
March	37,626	41,288	48,446	51,936	31,054	47,850	34,293
April	33,702	30,429	44,057	16,335	28,154	38,764	32,712
May	35,474	32,276	47,690	21,005	34,057	39,841	38,186
June	37,167	31,458	47,083	23,096	34,635	46,095	37,685
July	39,582	33,346	46,707	17,602	31,047	45,988	43,425
August	44,883	35,923	50,578	26,755	35,291	49,974	43,613
September	46,817	42,376	47,841	42,463	35,870	50,241	48,209
October	53,203	48,414	50,907	46,733	44,687	53,278	57,200
November	50,780	42,102	44,425	46,900	36,805	52,576	19,006
Total 11 months	470,151	437,421	523,323	374,180	384,272	515,410	428,625
December	.....	46,266	41,242	48,088	31,650	53,257	37,235
Total, year	.....	483,687	564,565	422,268	415,922	568,667	465,860

*As reported to the government by firms, individuals and association.

Flexible Glass May Be Made in England

According to reports in the press, the new glass invented by Austrian chemists, which bends, bounces and breaks without splintering, is soon to be manufactured in England. Experts declare it can be made at the same cost as the ordinary brittle glass.

Describing the new substance, the magazine *Motor* says it retains its clarity under all atmospheric conditions, and that in resiliency tests it bounces like a rubber ball.

Chippawa-Queenston Plant Has 500,000-Hp. Capacity

An official statement has been issued by C. A. Magrath, chairman of the Ontario Hydro-Electric Power Commission, concerning the power capacity of the Chippawa-Queenston development. The figures given relate to the week of Dec. 8. "During the week," the statement reads, "when the peak demand for the year was being carried, this plant delivered over 500,000 hp. on several successive days, while on Monday, Dec. 14, a peak load of 552,000 hp. was delivered to the Niagara system." Dredging in the canal and the Welland River has hitherto prevented an authoritative estimate as to the total output capacity of the plant.

President Appoints New Sesqui Advisory Body

The appointment of former Solicitor General James M. Beck to the chairmanship of the National Advisory Commission to the Sesqui-Centennial International Exhibition Association was announced by President Coolidge recently. At the same time the identity of distinguished men and women who will represent the various states on that Commission was made known.

As a result of the appointments, Secretary of State Kellogg and Secretary of Commerce Hoover, who constitute the National Sesqui-Centennial Exhibition Commission, will have an additional organization to aid them in their work. The celebration will open June 2, as originally planned. This was announced on Jan 20 after a conference of members of the National Advisory Commission, the Sesqui-Centennial Exposition Association and leading business men.

$500,000,000 Power Properties Linked by New Merger

The formal announcement of the Northeastern Power Corp., which is to link public utilities extending across New York and Massachusetts from Buffalo to Boston and reaching into Connecticut, Rhode Island and Vermont, was made on Jan. 20. The properties to be linked have a valuation in excess of $500,000,000.

Among the interests represented on the Board of Directors of the company are the General Electric Co., Power Corporation of New York, Mohawk-Hudson Power Corp., Buffalo, Niagara and Eastern Power Corp. and the New England Power Association, successor to the New England Co. A notice of the organization of this company is found on page 160 of this issue. The territory covered by the merger consumed 6,000,000,000 kw.-hr. of energy last year. The new company is to acquire the Power Corporation of New York through an exchange of stock and is to purchase for cash 173,333 shares of common stock in the New England Power Association.

Columbus, Ohio, Pickaway Plant Ready This Year

The improvement and extension program of the Columbus Railway Power & Light Co., Columbus, Ohio, involving an expenditure of $11,000,000, will be completed by the company this year, according to an announcement made by C. C. Slater, vice-president and general manager. Some of this work has been under way for two years. Other work expected to cost $3,000,000 will be started this year.

The new Pickaway power plant, erected about 11 miles south of Columbus in Pickaway County, at a cost of $7,000,000, with provisions for more than doubling its capacity at a total expense of more than $16,000,000, is being erected. This plant will have a capacity of 60,000 kw. when it is placed in service this year. Additional units will be built as needed to bring its total capacity to 150,000 kilowatts.

The Big Walnut power station, which will be continued in use with other power equipment owned by the company, brings the combined capacity up to 66,000 kw. at present. The Spring Street station, the last power plant inside the corporation limits, will be abandoned eventually, said Mr. Slater.

Tennessee Valley Rivers Development Plans

An application for a preliminary permit covering the Cove Creek site on Clinch and Powell Rivers in the Tennessee Valley, has been filed with the Federal Power Commission by the Union Carbide Co., of Richmond, Va., a subsidiary of the Union Carbide & Carbon Co., of New York. This application is in direct conflict with the application of the East Tennessee Development Co. and of the Tennessee Hydro Electric Company.

The Carbide company plans call for a maximum development of this important site. It is proposed to build four dams and power houses. The head that will be obtained at the respective dams is estimated at 36, 60, 15 and 225 ft., respectively. The installation proposed at the power houses is 30,000 hp., 50,000 hp., 13,000 hp., and 200,000 hp.

The contention for this site will be largely a struggle to determine whether the power is to be used chiefly for industrial or for public-utility purposes.

Southeastern Power Merger Announced

A plan to bring the Southeastern Power & Light Co. and the Georgia Railway & Power Co. under a single management was made on Jan. 21 by Thomas W. Martin, president of the former company. The Georgia Power Co. has been developing the power on the Tugalo, Tallulah and Chattooga Rivers in North Georgia. "This new arrangement will make possible cooperative development and conservation of water-power resources in the various watersheds of Alabama and Georgia, reinforced with large auxiliary steam plants advantageously located in the Alabama coal fields," President Martin said.

Patent Rights of Government Employees To Be Protected

So as to clarify the law of 1883 as to government employees' patents, the War Department has drafted new language which Senator Ernst of Kentucky has introduced as Senate 2354. In its present form the intention of the legislation is to give the government employee absolute protection against infringement in the handling of his patents. The language of the proposed legislation is as follows:

The Secretary of the Interior and the Commissioner of Patents are authorized to grant, subject to existing law, to any officer, enlisted man or employee of the government, except officers and employees of the Patent Office, a patent for any invention of the classes mentioned in Section 4886 of the Revised Statutes, when such invention is used or to be used in the public service, without the payment of any fee: Provided, That the applicant in his application shall state that the invention described therein, if patented, may be manufactured and used by or for the government or any of its officers or employees in the prosecution of work for the government or by any other person in the United States, for governmental purposes, without the payment to him of any royalty thereon, which stipulation shall be included in the patent: Provided further, that the head of a department or independent bureau certifies that the invention is used or likely to be used by or for the government for governmental purposes: and further that the patent shall be void unless the inventor or his licensee or his assignee pays the usual fees for obtaining a patent to the Commissioner of Patents within thirty days after any royalties are collected or any use of the invention not by or for the government is authorized under the patent.

Stokers Sold, Horsepower, and Kinds of Installation, 1925

Year and Month 1925	Establishments Reporting (Number)	Stokers Sold, Number	Installed Under—Fire-Tube Boilers—Number	Fire-Tube Boilers—Sq.Ft. Heating Surface	Installed Under—Water-Tube Boilers—Number	Water-Tube Boilers—Sq.Ft. Heating Surface
December	13	108	21	38,950	87	432,090
November	13	76	8	12,600	68	322,010
October	13	114	22	38,640	92	495,870
September	13	119	34	75,630	85	305,920
August	13	91	27	38,800	64	259,850
July	13	147	30	50,750	117	536,440
June	13	128	26	46,250	102	394,700
May	13	122	23	39,340	99	516,540
April	13	120	23	58,930	97	417,340
March	13	131	17	24,460	114	686,530
February	13	135	28	49,050	107	413,930
January	13	57	4	8,700	53	270,010

Virginia Engineers Discuss Industrial Needs

The Virginia Section of the American Society of Mechanical Engineers held a well-attended meeting Jan. 16, at which Past-President Harrington, of Kansas City, was the principal speaker.

At the dinner preceding the meeting, Calvin Rice, secretary of the society, pointed out that the South needed engineering research workers, stating that the present civilization is largely due to those scientific workers of a century ago. The South was neglecting its opportunity if steps were not taken to investigate all the possibilities of cotton and other products. At present no other country can compete with the cotton states. But just as the British scientists had solved the rubber problem and as a result caused Brazil to lose her monopoly of British Empire trade, so it was quite probable that some day another country might contest the South for cotton supremacy.

The speaker felt that the Virginia engineering schools should be more generally supported, and spoke in enthusiastic praise for the institution of industrial museums where the "how of things" would be revealed to the growing youth.

Inasmuch as cheap power is a necessity if high production be obtained, the speaker voiced the opinion that Virginia should harness her water powers.

In his address, Past-President Harrington stated that almost all of the present-day civilization had seen its origin within the last 150 years. He remarked that 100 years ago it took as long to go from London to Rome as was required at the beginning of the Christian era, while at present, the airplane trip is made in but a few hours. All this is due to what he termed the "Industrial Revolution." The development has been greatest in the United States, for the reason that here the natural resources of raw material and cheap power were most available.

Virginia was blessed with cheap fuel but needed an industrial awakening. The people were not alive to the possibilities, and even bankers were satisfied to devote their lives to trade rather than to the encouragement of industrial development. The speaker thought that the South had not yet arrived at a fair understanding of the value of engineering. In turn, this causes the able engineer to seek other parts of the country where his ability receives a better recognition. This attitude on the part of the Southern banker and business men is partly due to the engineer's failure to impress his personality upon those with whom he contacted. As a result, he is regarded as an employee and seldom as a member of the firm. An engineer should understand economics and appreciate the fact that things technical may be economically unsound.

A note of warning was uttered over the South's attitude on industrial activities. Farming is almost the only industry that is supported, and as a result the land is being drained of its wealth and the raw products converted into finished goods elsewhere. The South needs industries, and the speaker declared that it was up to the engineer to awaken this section to the opportunities slipping through its fingers.

British Government Plans Control of Electric Power

Great Britain is to make a determined effort to overtake the United States in the matter of developing cheap electricity for industrial, agricultural and domestic purposes. The British government's scheme for this purpose has long been under discussion and its nature is now fully disclosed.

Speaking at Birmingham on Jan. 15 Mr. Baldwin gave particulars which show that it is to be even more far-reaching than was anticipated. A national board of experts is to be appointed with wide powers to construct central power stations, also to own the main transmission cables and to compel existing electricity companies to link up. The generating stations now numbering 584 throughout Great Britain are to be reduced to 60 by eliminating all which are small and inefficient.

For this purpose the standardization of current is to be carried out by the board at a cost of £10,000,000.

The board is to raise its own capital, backed by government credit. Any profits it makes will be distributed among electricity purchasers.

It is to begin with the main industrial area included within a circle drawn through London, Bristol, Glasgow, and Edinburgh.

Obituary

Charles E. McFarlan, president of the Wm. Powell Co., manufacturer of valves, Cincinnati, Ohio, died on Jan. 1, 1926.

Hollon C. Spaulding, long prominent in power-plant engineering circles, died at New York Hospital on Dec. 24, 1925. Major Spaulding was born in Janesville, Wis., in 1865, and received his early education at the Boston Latin School. He later entered the M.I.T., from which he graduated in the class of 1887, with the degree of B.S. in civil and mechanical engineering. He began his engineering career in 1888 with the Worthington Pump & Machinery Co. Following this he was in charge of the motor department of the Thomson-Houston Electric Co. Between 1890 and 1896 Major Spaulding was secretary of the Thomson Vanderpoele Electric Mining Co. at Lynn, Mass., and manager of the J. A. White Co. at Exeter, N. H. Upon the entrance of the United States into the World War, Major Spaulding entered the army as a captain in the Ordnance Department. He served respectively as office manager of the Purchase Division of the Ordnance Department in Washington, as Officer in Charge of the Construction and Repair Division of the Army Transport Service at Bush Terminal, New York, and finally as Port Quartermaster for the United States Army at Halifax, Nova Scotia. Before entering the Army in 1917, Major Spaulding became manager of the Contract Department of the New York Steam Co. Previous to that connection he became manager of the Hoist Department of the Yale & Towne Manufacturing Co. at New York. He was an assistant editor of *Power* from 1920 to 1921 and a member of the A.S.M.E. Major Spaulding is survived by a wife, and son, Forrest B. Spaulding, of Syracuse, N. Y.

Personal Mention

J. F. Lumsden, electrical engineer of the Nova Scotia Power Commission, has been appointed assistant chief engineer.

W. L. Collier, formerly chief engineer of power stations of the Southwest Electric Light & Mill Co., Sarcoxie, Mo., which was recently bought by the Ozark Utilities Co., is now manager of the Sedan Electric Light & Power Co., serving Sedan, Peru, Elgin and Chautauqua.

Wingrove Bathon has recently established a Public Utility News Association at 30 National Savings & Trust Bldg., Washington, D. C., which will feature the weekly news and news comment features of activities concerning public utilities at the National Capitol for the use of the press generally.

George Uhler, Inspector General of the United States Steamboat Inspection Service, tendered his resignation of that office to take effect on Jan. 1, 1926. General Uhler is 72 years of age and has held this important office for the last 23 years, President Roosevelt having appointed him to the position in 1903. The General was tendered a farewell dinner by the American Steamship Owners Association at the Waldorf, New York City, on Jan. 14. **D. N. Hoover**, who has been General Uhler's assistant for a number of years, has been appointed as his successor.

G. F. Klein, formerly connected with the Cahokia station of the Union Electric Light & Power Co., St. Louis, has severed his connection with that utility to become chief operating engineer of the Staley Manufacturing Co., of Decatur, Ill. Mr. Klein's connection with the Union company dates back to 1917, when he entered the steam-heating department as mechanical engineer. Previous to being placed in charge of the Cahokia station in 1923, he served as superintendent of isolated plants and as assistant chief engineer of the steam-engineering department.

Society Affairs

The A.I.E.E. will hold a regional meeting at Cleveland, Ohio, March 18-19. Technical papers on sectionalized electrical drive, coal handling, conveying and electrical refrigeration will be given. Inspection trips as well as a dinner will be additional attractions, it is reported.

The Metropolitan Section of the A.S.M.E. will hold a joint meeting with **the American Division of the Société des Ingenieurs Civils de France** on Jan. 27 at the Engineering Society Building, 29 West 39th St., New York City. Henry Harrison Suplee, consulting en-

gineer, will give an address on "The Economic and Industrial Recovery of France." He is expected to have something to say regarding the high-head hydro-electric developments in the mountain provinces of Dauphine and Savoie in the south of France.

The Engineering Institute of Canada's general and professional meeting, which is to be held at the King Edward Hotel, Toronto, Jan. 27-29, will have three papers on the "Fuel Problem of Canada," which are expected to bring out a widespread discussion of this question.

The Engineering Profession of Michigan will hold a joint meeting at Hotel Tuller, Detroit, Feb. 4-5, with twenty-one engineering societies and local sections, the engineering faculties of the University of Michigan, College of Mines and Michigan State College, and individual groups from the ten leading industrial centers of Michigan. The program will include addresses by: John R. Freeman, past president of the A.S.M.E., who will speak on "Regulations of the Great Lakes" with discussion by five engineers active in this work; William B. Stout and C. F. Kettering, who will speak on airplanes and aircraft engineering progress.

Business Notes

The Riley Power Equipment Co., Milwaukee, Wis., is the new name of the former Riley-Fredericks Co., sales representative of various power plant manufacturers' products, in this territory.

The Griscom-Russell Co., manufacturer of evaporators, water heaters, oil and water coolers and steam specialties, has removed its main office to 285 Madison Ave., New York City.

The Detroit Stoker Co., Monroe, Mich., has just completed its new foundry buildings in connection with its plant. Equipment is being placed and operations will begin about Feb. 15.

The Terry Steam Turbine Co., Hartford, Conn., announces the appointment of John M. Rittelmeyer, 332 Healey Bldg., Atlanta, Ga., as its sales representative for the territory in the vicinity of Atlanta.

The Gladding Engineering Co., is the name of a new firm that will engage in general engineering practice at Wilson, N. C. R. D. Gladding, Richard P. Lent and J. H. Clark, Jr., are the engineers incorporating.

The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., announces that John Andrews, Jr., former manager of the Cleveland branch office, has been made manager of the Detroit district, effective Jan. 15. He succeeds C. C. Owens, resigned.

The American Schaeffer & Budenberg Corp., South Fifth St., Brooklyn, N. Y., announces that: H. V. Carlier, formerly sales promotion manager of the company, has joined the staff of the National Liberty Insurance Co., of New York City, owned by the same interests, as publicity manager; G. A. Binz, sales manager of the company, has taken charge of the advertising department.

Coming Conventions

American Boiler Manufacturers Association. D. W. Glanzer, 840 Rockefeller Bldg., Cleveland, Ohio. Meeting at Mid-Day Club, Cleveland, Ohio, Feb. 12

American Institute of Electrical Engineers. F. L. Hutchinson, 29 West 39th St., New York City. Convention at Engineering Building, New York City, Feb. 8-12.

American Institute of Mining & Metallurgical Engineers. Dr. H. Foster Bain, 29 West 39th St., New York City. Annual meeting at Engineering Societies Bldg., New York City, Feb. 15-17.

American Oil Burners Association. Leod D. Becker, 350 Madison Ave., New York City. Annual convention and exposition at Book Cadillac Hotel, Detroit, Mich., April 6-8.

American Society for Testing Materials. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa. Convention at Haddon Hall, Atlantic City, N. J., June 21-25.

American Society of Heating & Ventilating Engineers. F. C. Houghten, 29 West 39th St., New York City. Annual meeting at Hotel Statler, Buffalo, N. Y., Jan. 27-29.

American Society of Mechanical Engineers. Calvin W. Rice, 29 West 39th St., New York City. Spring convention at San Francisco, Calif., June 28-30.

Association of Municipal Electric Utilities. S. R. A. Clements, 190 University Ave., Toronto, Canada. Convention at Toronto, Ont., Jan. 27-28.

Electric Power Club. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio. Convention at The Homestead, Hot Springs, Va., May 24-27.

Engineering Institute of Canada. Richard John Durley, 176 Mansfield St., Montreal, Que. Annual meeting at Toronto, Ont., Jan. 27-29.

Heating & Ventilating Exposition. E. P. Frenz, Hotel McAlpin, New York City. Exposition at new Madison Square Garden, New York City, Mar. 17-23.

Iowa Engineering Society. J. S. Dodds, Box 202, Ames, Iowa. Convention at Mason City, Jan. 27-29.

Master Boiler Makers Association. Harry D. Vought, 26 Cortlandt St., New York City. Annual convention at the Statler Hotel, Buffalo, N. Y., May 25-26.

Midwestern Engineering Exposition, Inc. George E. Pfisterer, 53 West Jackson Boulevard, Chicago, Ill., general manager. Exposition and power show to be held in Chicago, American Exposition Palace, Jan. 26-30.

National Electric Light Association. A. Jackson Marshall, 29 West 39th St., New York City. Forty-ninth convention and manufacturers' exhibition, at Atlantic City, Young's Million Dollar Pier, May 17-21.

Power Show. International Textile Exposition—James F. Morgan, 53 Devonshire St., Boston, Mass. Power Show will be Department "D" of the International Textile Exposition, and will be under the auspices of the New England Association of Commercial Engineers, and held at the Mechanics Bldg., Boston, Mass., April 12-17.

Sesquicentennial International Exposition. Capt. Asher C. Baker, director in chief, Independence Square, Philadelphia. Exposition to be held in Philadelphia, Pa., from June 1 to Dec. 1.

Society of Automotive Engineers. Coker F. Clarkson, 29 West 39th St., New York City. Annual meeting at the General Motors Bldg., Detroit, Mich., Jan. 26-29.

Western Association of Electrical Inspectors. W. S. Boyd, 175 West Jackson Blvd., Chicago, Ill. Meeting at Hotel Sherman, Chicago, Ill., Jan. 26-28.

Trade Catalogs

Electric Supplies—The Graybar Electric Co., Inc., Pershing Sq., New York City, successor to the Supply Department of the Western Electric Co. Electrical Supply Year Book 1926-27 is cloth bound, contains 1012 pages and is illustrated profusely.

Compressors — The American Engineering Co., Philadelphia, Pa. Juruick ammonia compressors are described in a new catalog issued by this company. These compressors are made in 2-ton to 25-ton sizes and can be installed for hand or automatic control. Illustrations in the catalog show the mechanical details of the compressors and also views of the machines installed in a wide variety of industries using refrigeration.

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; **mine run** except Pittsburgh gas slack:

Bituminous, Net Tons	Market Quoting	Jan. 18 1926
Pool 1	New York	$2 85@$3 25
Smokeless	Boston	2.15
Clearfield	Boston	1.75@ 2.20
Somerset	Boston	1.90@ 2.35
Kanawha	Columbus	1.55@ 1.85
Hocking	Columbus	1.75@ 2.00
Pittsburgh	Pittsburgh	2.00@ 2.10
Pittsburgh gas slack	Pittsburgh	1 50
Franklin, Ill.	Chicago	2 35@ 2.65
Central, Ill.	Chicago	2.25@ 2.35
Ind. 4th Vein	Chicago	2 25@ 2.35
West Ky.	Louisville	1.25@ 1.50
S. E. Ky.	Louisville	1 40@ 1.75
Big Seam	Birmingham	2.00@ 2 25
Anthracite, Gross Tons		
Buckwheat No. 1.	New York	$2.50@$2.75
Buckwheat No. 1.	Philadelphia	2.50@ 3.00
Birdseye	New York	....

FUEL OIL

New York—Jan. 21, light oil, tank-car lots; 28@34 deg. Baumé, 5¼c. per gal.; 36@40 deg., 5½c. per gal., f.o.b. Bayonne, N. J.

St. Louis—Jan 12, tank-car lots, f.o.b. St. Louis; 24@26 deg., $2.05 per bbl.; 26@28 deg., $2.10 per bbl.; 28@30 deg., $2.15 per bbl.; 30@32 deg., $2.20 per bbl.; 32@36 deg., gas oil, 5.5c. per gal.; 38@40 deg., 6¼c. per gal.

Pittsburgh—Jan. 12, f.o.b. local refinery; 30@34 deg., fuel oil, 6c. per gal.; 36@40 deg., fuel oil, 6½c. per gal.

Dallas—Jan. 16, f.o.b. local refinery; 26@30 deg., $1.65 per bbl.

Philadelphia—Jan. 15, 27@30 deg., $2.31@$2.37 per bbl.; 18@22 deg., $1.75@$1.81; 13@19 deg., $1.68@$1.74 per bbl.

Boston—Jan. 16, tank-car lots, f.o.b. heavy oil, 12@14 deg. Baumé, 4.5c. per gal. light oil, 28@32 deg. Baumé, 5¾c. per gal.

Cincinnati—Jan. 19, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 6½c. per gal.; 26@30 deg., 6¾c. per gal.; 30@32 deg., 7c. per gal.

Chicago—Jan. 19, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 92c. per bbl.; 24@26 deg., $1.30 per bbl.; 26@30 deg., $1.35; 30@32 deg., $1.40@$1.45.

New Plant Construction

Ala., Montgomery—Independent Ice Co., 113 North Lawrence St., awarded contract for the construction of an ice plant, 100 ton daily capacity to S. O. Estes & Co., 23 Adams St. Estimated cost $200,000.

Ark., El Dorado—Gann Ice Plant Co., plans the construction of an ice plant. Estimated cost $30,000.

Calif., Los Angeles—H. B. King, et al, c/o Fisher, Lake & Travers, Edwards-Wildey Bldg., Engrs., is having preliminary plans prepared for the construction of an ice and cold storage plant, ice manufacturing plant, etc. Estimated cost $150,000.

Calif., Mare Island—Bureau of Yards and Docks, Navy Dept., Washington, D. C., will receive bids until March 3rd for the construction of a hospital including heating plant, etc., here.

Calif., Wasco — Wasco Public Utilities Dist., will receive bids until Feb. 2 for improvements to waterworks including the installation of two deep well pumping plants, etc.

Conn., Hartford—Hotel Bond, H. S. Bond, V. Pres., 320 Asylum St., is having plans prepared for the construction of addition to hotel. Estimated cost $1,500,000. Pennington & Lewis, 25 Park Ave., New York, N. Y., are architects.

Fla., Lakeland—Lakeland Cold Storage Co., R. H. Alderman, Pres., plans the construction of an ice and cold storage plant. Estimated cost $125,000.

Fla., St. Lauderdale—W. F. Morang & Sons, 162 East Flagler St., Miami, will build a 6-story hotel at Coastal Canal and Middle River here. Estimated cost $1,400,000. J. M. Peterman, c/o owner, is architect. R. A. Belsham, c/o owner, is engineer.

Ga., Atlanta—T. K. Ice Co., 860 East Fair St., awarded general contract for the construction of an ice and cold storage plant to Barge-Thompson, 100 East Fair St., $21,536.

Ill., Chicago—McNally & Quinn, 6 South La Salle St., Archts., is receiving bids for the construction of a 15 story apartment at 424 Melrose St. for W. C. Bannerman & Co., 77 West Washington St. Estimated cost $2,100,000. Quinn & Christensen, 360 North Michigan Ave., are associate architects.

Ill., Chicago—St. Ann's Hospital, 4900 Thomas St., is having plans prepared for the construction of a 4 story hospital at Lavergne and Lamon Aves. and West Division and Thomas Sts. Estimated cost $900,000. H. J. Gaul, 228 East Superior St., is architect.

Ill., Chicago—Sanitary Dist., H. E. Wallace, Clk., 910 South Michigan Ave., will receive bids until Jan. 28 for furnishing 1 six-cylinder marine type gasoline engine with reversing gear, necessary propeller shaft and propeller as a complete power unit with all accessories in boat "Robert R."

Ill., Chicago—A. Strunk, 69 Bellevue Place, will soon award contract for the construction of a 15 story hotel at 17-19 East Ohio St. Estimated cost $725,000. R. C. Harris, 190 North St., is architect.

Ill., Melrose Park—City will receive bids about June 1 for a 1,000,000 gal. reservoir, new deep well, pumping equipment, etc. Estimated cost $90,000. E. Hancock, 2047 Ogden Ave., Chicago, is engineer.

Ind., Anderson — City, M. H. Douney, Engr., City Hall, will receive bids until Feb. 10 for three deep water wells, pumps and complete equipment.

Ind., Terre Haute—Indiana Electric Corp., 2701 South 8th St., awarded contract for the construction of addition to substation to Stone & Webster, 147 Milk St., Boston, Mass. Estimated cost $250,000.

Kan., Topeka—Christ Hospital, awarded contract for the construction of a 4 story hospital, including power plant, swimming pool, etc., to Senne Construction Co., 518 Kansas Ave. Estimated cost $500,000.

Md., Conowingo—Stone & Webster, 120 Broadway, New York, N. Y., awarded subcontracts for the construction of a dam, etc., for the hydro electric plant near here to Arundel Corp., Pier 2, Pratt St., Baltimore, for Susquehanna Power Co. (owned by Philadelphia Electric Co., 20th and Chestnut Sts., Philadelphia, Pa.). Approximately $20,000,000.

Mich., Detroit—J. J. Barlum, 206 East Grand River Ave., awarded contract for the construction of a 21 story hotel at Cadillac Square to Otto Misch Co., 159 East Columbia Ave. Estimated cost $2,50,000. Steam heating equipment will be installed.

Miss., Moss Point—City Clerk will receive bids until Feb. 9 for improvements to waterworks system, including 100,000 gal. tank on tower, water well, 300,000 gal. reservoir, pumping equipment, etc. $125,000 bonds have been voted. H. A. Mentz, Hammond, La., is engineer.

Mo., Macon—City will receive bids about Jan. 27 for improvements to sanitary sewage system, including two 275 g.p.m. centrifugal sewage pumps with motors, Imhoff tank, etc. Estimated cost $25,000. Rollins & Co., 521 Railway Exchange Bldg., Kansas City, are engineers.

N. J., Lambertville—New Jersey Rubber Co., C. M. Dilts, Supt., plans the installation of 2 new refiners, 3 batching mills and one grinder to be operated by a 400 hp. motor. Engineer not selected.

N. Y., Kings Park—State Hospital Commission, Capitol, Albany, will soon receive bids for electric generators and air compressors for Kings Park State Hospital. S. W. Jones, Capitol, Albany, is state architect.

N. Y., New York—F. Dee & L. Realty Co., I. Lasner, Pres., 146 West 34th St., plans the construction of a 24 story office building at Madison Ave. and 32nd St. Architect not selected.

N. Y., New York—B. M. House Sons, 8 West 40th St., plans the construction of a 16 story apartment at 2nd Ave. and 38th St. Architect not selected.

N. Y., New York—Park Avenue Leasing Corp., c/o G. L. Miller, 1482 Broadway, Archt., is having plans prepared for the construction of a 15 story apartment at 100 West 58th St. Estimated cost $2,000,000.

N. C., Waynesville—The Pigeon River Power Co., associated with the Electric Bond & Share Co., 65 Broadway, New York, N. Y., plans the construction of a hydro-electric power development on the Pigeon River near here. Estimated cost $12,000,000. Engineer not announced. C. S. Walters, V. Pres. of the Asheville Power & Light Co., Asheville, is interested.

O., Cleveland — The American Steel & Wire Co., Rockfeller Bldg., awarded steel contract for a boiler house on Broadway to American Bridge Co., Frick Bldg., Pittsburgh, Pa. Estimated cost $200,000.

Okla., Cushing—Mayor and City Council, is in the market for a low lift pump to raise water from lake to filter plant.

Okla., Edmond—Edmond Ice Co. has work under way on the construction of addition to ice plant. Owner will purchase machinery and equipment. Cost $15,000.

Okla., Heavener—City, J. H. Brannon, Mgr., is in the market for a 350 g.p.m. centrifugal pump against a 300 ft. head.

Okla., Inola—City plans an election Feb. 2 to vote $23,000 bonds for the construction of a waterworks system including deep well pump, tank on tower, etc. Gantt-Baker Co., 1116 West Main St., Oklahoma City, is engineer.

Pa., Mill Hall—Harbison-Walker Brick Co., Mount Union, plans the construction of a brick manufacturing plant including power plant, crushers, etc. here. Estimated cost $150,000.

Pa., Philadelphia—David Barton, Trustees, will soon award contract for the construction of a 12 story office building at Juniper and Arch Sts. Estimated cost $500,000. L. B. Rothschild, 215 South Broad St., is architect.

Pa., Philadelphia — Emergency Aid of Pennsylvania, Mrs. J. W. Martin, Secy., 21st and Walnut Sts., awarded contract for the construction of a 14 story hotel at 20th and Sansom Sts., to Wark Co., 1600 Walnut St. Estimated cost $850,000.

S. C., Greenville—Laurel Park Estates Co. Inc., H. W. Fuller, Pres., plans the construction of a hotel at Caesar's Head mountain. Estimated cost $1,000,000. Beacham & Legrand, are architects.

Tenn., Big Sandy—Big Sandy Ice Co., W. L. Goforth, Pres., wants prices and data on equipment for a 10 to 20 ton ice plant.

Tex., Bastrop—Texas Public Utilities Co., subsidiary of the Texas Power & Light Co., Waco, plans the installation of an electrically driven engine, refrigeration machinery, etc., for ice plant. Estimated cost $18,000. Private plans.

Tex., Brackettville—Brackettville Ice & Power Co. is having surveys made for a 20-ton additional unit to ice plant, also extensions to power plant to double the capacity of the plants. Estimated cost $30,000 and $25,000 respectively. Dynamos, engine, etc., will be required.

Tex., Junction—West Texas Utilities Co., G. W. Fry, V. Pres. and Gen. Mgr., Abilene, has acquired the local electric plant here and plans extensions. Estimated cost $40,000. New dynamos, engines, etc., will be required.

Tex., Kenedy—Texas Central Power Co., S. M. Udden, Mgr., Frost Bank Bldg., San Antonio, is having plans prepared for the construction of a 30-ton ice plant here. Estimated cost $50,000. Private plans.

Tex., Marshall—City plans an election soon to vote $50,000 for improvements to waterworks including pumping equipment, mains, etc. M. Ramsey, City Hall, is engineer.

Tex., Pharr—D. McClendon and M. H. Lowrie, will build a cold storage plant by day labor on Missouri-Pacific right-of-way. Estimated cost $20,000. Private plans. Machinery will be purchased.

Tex., Rosenberg—South Texas Utilities Co., plans the construction of a 15-ton addition to ice plant to double the capacity. Estimated cost $30,000. Private plans. Machinery, etc., will be required.

Tex., San Angelo—M. D. & W. F. Kennemer, will build a 50 ton ice plant on North Chadbourne St. by day labor. Estimated cost $100,000. Private plans.

Tex., San Antonio—T. B. Baker Hotel Co., Gunter Hotel, plans the construction of a 300-room addition to hotel, including heating and lighting units, cooling system, elevators, etc., at Houston and St. Marys Sts. Estimated cost $800,600. H. S. Green, Almo National Bank Bldg., is architect.

Wis., Menomonie—Stout Institute, B. E. Nelson, Pres., will receive bids until Jan. 27 for two 125 hp. return tubular boilers, two 10 kw., 115 v. engine generator units with accessories and two 8 x 5 x 10 single direct-acting boiler feed pumps for power plant. C. A. Halbert, Capitol, Madison, is state engineer.

Wis., Milwaukee—Red Star Yeast & Products Co., 79 Buffalo St., awarded contract for the construction of addition to engine and blower house on 27th St. to Universal Construction Co., 915 Chestnut St. Estimated cost $50,000.

Wis., North Fond du Lac—(Fond du Lac P. O.)—Village, E. E. Adams, Clk., plans an election Jan. 26 to vote $13,000 for the purchase of 2 sewage pumps. J. Donohue Engineering Co., 608 North 8th St., Sheboygan, is engineer.

B. C., Nelson—West Kootney Power & Light Co., Bonnington Falls, awarded contract for extensions to dam above Lower Bonnington Falls, near here, to McDougall & McCharles, Nelson. Estimated cost $60,000.

Ont., Fort William—Council plans the construction of an electric station and distribution system. Estimated cost $250,000. W. A. McNaughton, City Hall, is engineer.

Ont., Hamilton—Bd. of Education, plans to purchase electric pumps in connection with heat regulation equipment at the Benatto, Gibson, Victoria Avenue and Queen Mary Schools.

Ont., Port Arthur—Thunder Bay Paper Co., Ltd., is having plans prepared for the construction of a newsprint plant, 100 tons daily capacity. Estimated cost $1,000,000. Generators and motors will be required.

Que., Hull—Canadian International Paper Co., had plans prepared for the construction of a generating station and dam across the Ottawa River. Estimated cost $3,000,000. O. Lefeire, Montreal, is engineer.

Que., Montreal—Royal Bank of Canada, St. James St., plans the construction of a 16 story office building at St. James and St. Peter Sts. York & Sawyer, 100 East 42d St., New York, N. Y., are architects.